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THE TREND OF INTERURBAN RAILROADING.

It is exceedingly interesting to note the directions of growth in American interurban railway working. In the beginning the interurban road was merely an extension of the suburban road, much as the latter was an extension of the tramway. The suburban line gradually realized the need of higher speed and with this came the long car calling again for more powerful motors. When suburban systems began to grow into interurban ones, still more speed was necessary and with it still bigger cars and motors. The electric road began with, say, two 7½-hp motors per car. Then came 15-hp motors, and 20-hp and 25-hp. Presently even these were too small and 35, 40 and 50-hp became common. To-day the fast interurban cars are equipped very commonly with four 50-hp or 75-hp motors, and even 100-hp motors. The running speed has crept upward from 15 miles per hour to 30 and 40 and schedule time at certain points of some of the later roads rises to 50 or 60 miles per hour. Now it is well understood that frequent stops in high-speed service are troublesome and costly, so that instead of stopping on signal like the early tram cars, or every block or two, the interurban road has its stations a mile apart or so. In short, it stops no more frequently than the steam trains in suburban service, keeps up quite as fast a schedule, and operates express trains upon precisely the same principles as any other road. It has through an evolution, so gradual as to be inconspicuous, grown to full railroad stature, differing only in its motive power, the operation of short trains or single cars instead of relatively long trains, and in having a relatively free entrance to cities where ordinary trains would not be permitted. It has in large measure the opportunities of a steam road and the immunities of a tram car.

A very striking part of this evolution is in the extension of steam railway practice in minor matters to the interurban roads. For instance, railroads have for years found that in light service combination baggage and smoking cars have a useful place. They are to be found on every interurban road. And since long runs presuppose night travel, the trolley sleeper has its appointed place. In the beginning trolley lines ran on hourly or half-hourly time from the termini, providing a schedule that was easily carried in the public mind, and never demanding long waits. Recently some roads have found that to maintain this practice wasted some time of the train crews at termini and so they have gone over bodily to railroad schedules with their 7.11, 9.13 and 10.19 trains with long intervals in the middle of the day. Likewise instead of using ordinary electric cars with controllers at each end, the advanced wing of the interurban part uses regular combination dummies, operated from one end only and looped or turned at the termini. The interurban has, in fact, come to a sort of Dr. Jekyll and Mr. Hyde existence—within city limits it is a mild-mannered and god-fearing tram, meekly taking up passengers at the crossings—but once outside it is a cannon ball express with an arc lamp headlight warning the wayfarer to clear the track, and stopping when it gets ready. There is no substantial line that now separates interurban electric roads from any other railways; and instead of the much-talked-of electrification of steam roads the thing which has really happened wherever the steam roads have failed in controlling the legislature is

the building of a very extensive and useful system of competitive roads giving upon the whole excellent service at comparatively modest rates. As to the future, the case seems clear that the steam roads thus hard pushed must hold up their service to first-class competitive shape by steam, if they can, by electricity if they must. It very much looks as if they were being steadily forced to the latter alternative. When they change motive power they do it on a considerable scale, making a virtue of necessity, and taking a large place in the public eye. It is the result of no sudden conversion, however, or of fine and discriminating foresight, but of the insinuating pressure put upon them by the fast interurban lines that have been quietly going about their business and doing things. The evolution will from now on proceed more swiftly and we have strong hopes that it will not halt until the trunk lines themselves have surrendered at discretion.

The Columbus Convention.

Each meeting of the national street railway body has some characteristic given to it by its environment, and in this manner the meeting next week at Columbus becomes more particularly associated in the public mind with the development of interurban railways. Columbus is a remarkable center of such enterprise, comparing indeed in this respect with cities like Cleveland, Detroit and Indianapolis. The work of the convention will deal with aspects of this question, and the visitors to Columbus will be able to observe the manner in which the attempt has been made to deal with many of the problems arising in connection with this newer branch of street railway work. As at Detroit a few years ago, it will be found that the interurban railway has become a necessary factor of life to a very large percentage of the resident population and in many respects has significantly modified the social outlook for the rural communities through which the lines pass. The steam railroad has been a mighty factor in making for the welfare of the farmer, but it may be questioned whether the interurban trolley road does not in many respects get closer to the vital conditions of rural existence and promote far more than the steam locomotive was ever able to do the comfort, happiness and convenience of every member of the farm family.

As a branch of the electrical industry, the street and interurban railway continues to hold its own in magnitude and as an outlet for material, capital and outlet. A rapid growth is seen in both the city and the country of electric railway work, and a new feature opens up with the fact that the last day of September saw the entrance for the first time into New York City of the first electric locomotive operating over the New York Central tracks. It is really because of the coming into being of these larger units that the electric railway motor of the present time is not produced so numerously as it was a few years ago and costs the public less. In the census of 1900 it was found that during the year there was a production of 15,284 electric railway motors of an aggregate capacity of 66,669 hp, valued at $7,568,841. It would appear from the statistics of last year that the number of railway motors had declined to 12,298, while the capacity had risen to 713,181 hp, with a value of $4,949,795. It will thus be seen that the average size has increased considerably owing to the use of larger and heavier cars on street railways, while it is well known that the newer locomotives run into hundreds and even thousands of horse-power; hence the lesser cost of the apparatus to the operating roads.

The electric railway industry is indeed this year at one of the milestones and turning points in its history, for the work on the New York Central is being closely followed up by that on the Pennsylvania and New York, New Haven & Hartford and other systems, while the long line between Atlantic City and Philadelphia has just gone into operation. To what extent this adoption of electricity by the main trunk lines may affect the interurban development is not yet quite clear, but it is obvious that certain important results must follow from the creation of these new conditions, and it is equally certain that large as are the present figures of development, those of a few years hence will throw them into the shade.

Electricity on the Farm.

We have published from time to time various notes on the installation of power plants on a modest scale for farm use and similar domestic operations. It is a curious fact that the very first serious experimental use of electric power was for plowing, and the first real installation in regular operation was for running a hoist for handling beets in a sugar factory. It is a far cry from these beginnings in 1878 to the apparatus and methods of to-day, and it is a pity that more progress in the intimate connection of electric power with the life of the people has not been made. That it is possible to generate electric power for local use on a small scale with excellent results several recent descriptions of such plants testify. The coming of the gasoline engine has perhaps done more than anything else to encourage the local user of small power, and yet it is a demonstrable fact that where small, even very small water powers are available the gasoline engine can be badly beaten in the matter of economy. Where power is rarely needed and only in small amount the engine does extremely well, and it is available in many regions where nothing better exists, but with water power at hand it pays to look into its development.

There are hundreds of little falls scattered over the country which can be put to profitable use by private owners or groups of owners. Suppose for example a fall giving 20 hp or so located a mile from a village or a group of large farms. A score of horse-power requires only a modest flow of water, a few hundred cubic feet per minute at ordinary heads, and there is many an abandoned sawmill site that will give it and can be purchased for a song since the forests that gave it work have been ruthlessly swept away. A short log dam built or repaired a few scores or hundreds of feet of cheap flume and the hydraulic development is complete. The electrical situation is almost as simple. A frame power house the size of a modest corn barn will hold the wheel case, the 15-kw dynamo and the single small panel that constitutes the switchboard. Working at 550 to 600 volts the whole output can be sent down on a pair of four wires carried on say thirty poles. The result would be the delivery of power to 12 kw in motors capable of doing all the miscellaneous sawing, grinding, pumping and light motor work of the neighborhood, and at a pinch of furnishing power enough for a small factory if developed for such purpose. If desirable the same generator could be pressed into service for a hundred or so incandescents at night, the more easily by using 220-volt lamps in series. On this small scale the plant could run practically without attention other than to carefully inspect it at starting and stopping. In fact the latter could if desirable be made automatic. Many a small dynamo in factory use runs practically without attention. On a little larger scale a village association could get power and light at an extremely small cost. It is merely the farmer's telephone line idea expanded, and is similarly feasible, not as a corporate investment, but as a local convenience. It is a scheme certainly worth trying when the conditions are reasonably favorable, and in thousands of small places they are favorable.

Energy Losses in Central Station Distribution Systems.

It is customary in dealing with the expenses of electric distribution systems to refer them to the basis of the cost per kilowatt-hour generated at the switchboard. For similar and similarly operated systems this method of analyzing and comparing costs is both simple and effective; but, as is well known, in the cases of plants varying greatly in size, character and nature of service, the costs per switchboard kilowatt-hour of labor, fuel and other items differ materially and do not admit of intimate comparison. One of the causes for the discrepancy in referring to a switchboard kilowatt-hour as the standard of cost lies in the different amounts of loss that occur between the switchboard or switchboards and the customer's meters. In some cases the kilowatt-hour sold is therefore regarded as a more suitable basis of cost comparison than the switchboard kilowatt-hour. In yet other cases of central stations transmitting high-tension alternating current to sub-stations, the kilowatt-hour at sub-station switchboards is taken as the most suitable basis of comparison. It is evident that the cost per kilowatt-hour will differ appreciably according as the term refers to the high-tension switchboards, the low-tension switchboards or the consumers' meters.

The easiest quantity to determine is almost always the cost of a high-tension switchboard kilowatt-hour because there are only a relatively small number of registering meters to be consulted in arriving at the total number of annual or monthly kilowatt-hours. The low-tension switchboard kilowatt-hours require a summing up to be made of a larger number of instrumental records, and the metered or sold kilowatt-hours require for their determination a much longer process of summation. It would seem at first sight an easy matter to account quantitatively for the differences which naturally present themselves between the three total energy outputs at switchboards and meters, respectively. In a small central station system this may not be difficult; but in a large system, employing perhaps many different types of apparatus and machinery, the analysis is very complex and difficult, although a search into the matter is often of great value in indicating methods for economizing unexpected wastes. For this reason it is often impossible to determine the average meter error, or deficit due to meter inaccuracy, within narrow limits. The meter records necessarily lag a few weeks behind the switchboard records. In the course of a calendar year the total meter record should, however, equal the total switchboard record, after deducting losses in the system. But the constantly changing and increasing number of customers and output prevents the calendar year of the one from agreeing with the calendar year of the other, so that there always remains an appreciable percentage of uncertainty in the losses attributable to machinery, conductors and meters.

The Standardization of Current-Traction Motors.

The report has recently been published of the International Congress of Local Tramways and Railways, held at Milan last September, which contains a provisional series of 24 rules for the standardization of street car motors. A translation of this report appears on page 714 of this number. It does not appear that any American representatives attended, or were invited to attend, this Congress, or to serve on its committee of rules, although the subject is one in which American engineers and manufacturers are vitally interested, and in the development of which they have taken a prominent share. For this reason the title of the report is inaccurate. It should have been an international congress. It really was a European congress. The progress made towards standardization at this congress is remarkable, considering that the international committee on Standardization of Electrical Machinery, which met in London last June, with some fifty delegates from countries including the United States and Canada, was hardly able to accomplish more than a definite permanent organization. In spite of this incongruity we congratulate the Milan Congress upon its progress and activity. It is to be hoped that the work will be extended internationally through the national institutions representing electrical engineering.

The set of rules as a whole seems excellent. There are, however, various details in which we think amendment might advantageously be made. It is to be noted that the ratings of a motor are properly defined as the powers delivered by the motor itself, at its own shaft, under definite conditions of loading, with respect to temperature. The efficiency of a motor is also very properly defined as the efficiency of the motor itself, or what is virtually the ratio of power delivered at its own shaft to the power absorbed at its own terminals. But the speed of the motor is defined virtually as the speed of the car or truck to which the motor is applied, and not as the speed of the motor itself. This seems to be illogical. It is inaccurate to state the speed of a motor, which is naturally an angular velocity, or a certain number of revolutions per unit time—as the number of feet, meters or miles which a car wheel of a certain size, geared in a certain ratio of transmission to the motor shaft, will develop at its periphery in unit time. It would be just as inaccurate to define the speed of a moving street car as the number of revolutions per minute made by its driving motor. The logical way would seem to be to define the speed of a motor as the speed of rotation of its armature with respect to its field frame, and in addition to specify the ratio of gearing and diameter of car wheel tread, whereby the accompanying speed of the car may be inferred.

Similarly, although with less insistence, it seems desirable to define the tractive effort of a motor as its own individual torque, or the tractive effort it would deliver at a diameter of one meter on its own shaft, and not to define it, in general, as the effort delivered at the periphery of a certain attached car wheel. The effort delivered at the car wheel depends to some slight extent upon the friction in the connecting gearing, and this in turn upon the load. This range of inaccuracy would be avoided by adopting a logical definition with sole reference to what exists in the motor itself, allowing the tractive effort at the car axle to be inferred from the motor torque, the gearing ratio and the car wheel diameter. In other words, the tractive effort as defined is not that of the motor, but is that of the motor and gear together. The set of proposed Milan Congress rules do not deviate markedly from the corresponding rules in the standardization report of the American Institute of Electrical Engineers of 1902. The principal difference lies in the fact that the latter recommend a "service temperature" being predetermined with a reasonable degree of precision from the data for the expected conditions of service, and that practical tests should be made of the motors on a straight and level track under conditions simulating the equivalent service conditions, in order to observe the rise of temperature. There are, however, a variety of differences in detail between the two sets of rules, and efforts should be made as early as possible to eliminate such differences and to have one and only one set of rules all over the world.

The Wireless Conference in Berlin.

A special cable dispatch of October 4 from Berlin says: "The delegates to the International Wireless Telegraph Conference had a preliminary exchange of general views at the session to-day, from which it appeared that the British delegates were prepared to go further than previously supposed toward international regulation.

The attitude of the British has been awaited with the utmost interest because upon Great Britain's action the success or partial failure of the conference depends. The British delegates joined in the view that wireless telegraphy had developed to a point where international accord was desirable.

In this endeavor it is said to be quite possible that the Marconi company will yield sufficiently to make an agreement possible. The British course will probably be followed by Italy, which has similar relations with Marconi.

Agents of the principal wireless companies throughout the world are here watching the proceedings. The American delegates took luncheon to-day with Ambassador and Mrs. Tower.

Trolley Travel in New York City.

The remarkable effect of the Interborough Subway in building up its own patronage and in drawing away travel from the surface trolley lines is shown in the annual report of the New York City Railway Company, while it is also seen that the traffic intensifies on itself in a short time so as to equalize matters. The report exhibits a deficit of not less than $2,212,997. This is the extent to which the road fell behind in the twelve months ended June 30 last, not taking into account the special franchise tax which is in litigation. The amount of the tax levied against the New York City Railway Company, after deducting various franchise payments to New York City, was approximately $537,000. Were this included the deficit for the year would be increased to over $2,700,000. Last year, without taking the franchise tax into consideration, there was a deficit of $2,796,942, and the year before of $1,396,771.

The gross earnings of the system for the year amounted to $21,937,944, an increase of $1,047,820 over the previous year. This increase of about 5 per cent, President H. H. Vreeland says in his report, realizes the expected recovery due to the fact that the short-haul business is rapidly overcoming the loss of long-haul traffic that has gone to the Subway.

Real estate not needed in the operation of the road was further reduced this last year by the sale of several pieces upon which $516,000 was realized. The equipment of the company was increased by the purchase of twenty-five long open and twenty-five semi-convertible cars. In addition twenty-five large closed cars have been ordered for delivery this fall.

Electricity in Asia Minor.

Mr. William C. Magelsson, United States vice-consul-general at Beirut, states that an Imperial Turkish irade, sanctioning the construction of an electric tramway in Beirut, has been granted. The concession has been given for ninety-nine years in the name of Negib Pasha Melhame, a Syrian. Belgian capitalists immediately arranged to purchase the grant, and paid for the same the sum of $194,660. They have been compelled to pay $48,665 as a loyal donation to the Hedjaz Railway and deposit a certain amount with the Imperial Ottoman Bank by way of guaranty for the execution of the venture. The company will operate under the name "Société Ottomane Anonyme des Tramways et Eclairage Electriqué de Beyrouth," and its headquarters will be at Constantinople. Its capital is fixed at 6,000,000 francs ($1,158,000), divided into 60,000 shares. Three million six hundred thousand francs ($694,800) are to be fully paid up and the balance paid when needed. Each administrator of the company must possess at least 50 shares. There are to be four obligatory lines and three optional lines.

The gas company of Beirut has, by virtue of its concession, the optional right of lighting the city by electricity. If after three months' notice it should fail to undertake the work it will forfeit its privilege, and in that event the new company will take over the lighting. Various benefits will accrue from the introduction of the tramway. Besides furnishing a cheaper mode of transportation it will materially alter the present condition of the streets. They are to be macadamized and a proper system of sewers constructed. The rough roads will no longer exist. Mr. Magelsson suggests that interested parties communicate with "Société Ottomane Anonyme des Tramways et Eclairage Electriqué de Beyrouth," Constantinople, Turkey, which is apparently the promoter of the enterprise.

Electric Motor Equipment for the Indiana Steel Company.

At Gary, Ind., there is being constructed by the United States Steel Corporation an enormous plant for the manufacture of steel. The new plant when completed will make use of substantially 5,000,000 tons of ore per year and will produce annually nearly two and one-half million tons of steel. Along with the completion of the various buildings of the new plant an entirely new city is going up with parks, theatres, streets and water and sewage systems all planned. Quite in keeping with the immensity of this project are the plans for the detailed equipment. Practically all the machinery in the steel plant will be driven electrically, the gases from the blast furnaces being, as far as possible, used for the generation of the necessary power. One of the first buildings to be equipped will be the rail mill and the induction motors which will be used are not only of interest because of their size, but because of the special method of control. Moreover, this will be the first steel mill in this country to operate its rolls by induction motors. Six General Electric three-phase induction motors ranging in capacity from 2,000 to 6,000 hp will be used to drive the main rolls. These motors are reversible and are specially controlled. Due to the heavy overloads to which these machines are necessarily subjected, each motor is provided with a heavy fly-wheel which, with the system of control, stores up energy when running normally and returns it to the rolls when subjected to a heavy overload. In addition to the heavy fly-wheels each induction motor has an overload capacity of 50 per cent for one hour. Thus three of the motors having a normal rating of 6,000 hp can each deliver 9,000 hp for one hour when called upon to do so. Mechanically these motors are of the unusually sturdy construction, being built heavy and rigid to withstand the shocks to which they will be necessarily subjected. At the same time the construction is as simple as is consistent with reliability.

The method of controlling these motors was specially designed by the General Electric Company for this service and is very interesting. A master controller is used from which the main line oil switch can be opened or closed, the reversing switch thrown in either position or the resistance cut in and out of the rotor circuit in successive steps by means of electrically-operated switches or contactors. The main line switch is a triple-pole, single-throw electrically-operated oil switch and the current passing through this is led through the reversing switch, a double-pole, double-throw, electrically-operated oil switch. Special precautions have been taken to insure the automatic protection of the control system. It is impossible to operate the reversing switch unless the main line switch has been previously opened, and if the main line switch has been opened by the overload trip, it cannot be closed without first bringing the controller to the off position.

As has been stated, a special arrangement is used to assist the fly-wheel in restoring energy to the motor. So-called "slip relays" are provided in which the actuating coil carries the current of the motor. Whenever the motors are subjected to overloads the slip relays operate cutting a small portion of the resistance into each phase of the rotor circuit, causing the motor to slow down gradually and the fly-wheel to give up a portion of its energy. When the load is taken off the motor the reverse operation takes place and the motor speeds up, returning the energy to the fly-wheel.

Applied Science at Harvard University.

Commencing with the current year, Harvard University has established a graduate school of applied science, offering professional degrees in electrical engineering, civil engineering, mechanical engineering, architecture, landscape architecture, mining and metallurgy, forestry, applied chemistry, applied biology and applied geology. Admission to this school requires a bachelor's degree in arts, science or philosophy, or an equivalent previous training. The normal period of study required to complete the work set by the new graduate school of applied science is two years, and must be at least one year, the time depending in each case upon the candidate's previous preparation. Twenty-five students are enrolled in the school in this its opening year.

Engineering may now be studied in three different ways at Harvard University: First, by those who elect engineering subjects in the course of their work in Harvard College towards a degree of A.B. or S.B.; second, by those who select a prescribed four-year course of technical studies in the Lawrence scientific school, which school still continues its functions in that direction, offering degrees of S.B.; third, by those who enter the graduate school of applied science, usually as candidates for a professional degree. These three different methods provide for varied nominal periods of study of engineering, from half a year to five years, according to the aims and wishes of the student.

Along with the new graduate school of applied science, Harvard University offers for the first time a degree of S.B. to students in Harvard College on lines parallel to those for the A.B. degree. The admission requirements for the S.B. degree differ, however, from those of the A.B. degree in permitting modern languages to be substituted for ancient language.

Publicity and Corporate Cleanliness.

James R. Garfield, United States Commissioner of Corporations, addressing the School of Commerce, Accounts and Finance of the New York University at the opening exercises, held in the University Building, declared that publicity is the only cure for many of the abuses that have crept into the management of corporations and that unfair competition can only be corrected by the educated business man with a conscience which discriminates between right and wrong for him. He said:

"The systematic investigation of corporations has led to great reforms. Leaders of business are not insensible to public opinion. The bank director would not appropriate the depositors' funds, the railroad manager would not grant rebates if he knew that his acts would be made public the next day. It is often argued that publicity of corporate affairs is an invasion of individual rights. This is not so. When we find out what men have been doing as a corporation it is no invasion of individual rights. Secrecy in the affairs of a corporation, we have come to learn, simply means that something that should be known is being hidden.

"There is a great difference between the corporation and the individual. The corporation is a creature of the State; hence it should be controlled by the State. We can only know a corporation through its records. We learn to know an individual by his daily acts and his remarks. We know that the business of a corporation is better done when its records are open. When they are closed the actual value of corporation property may be concealed so that the value of the stock can be raised; the assets may be hidden to obtain exemption from taxation; debts may be concealed to give the corporation a prosperous appearance, and other pernicious things may be done.

"Another of the questions which the business man of the future must face is that of fair and unfair competition. The educated man should demand fair competition. Competition brings success to some men and to others a dismal failure. The man whose ideal is 'Business is business' soon adopts the creed, 'Anything to win.' As the pinch of competition comes this man tries to evade the law. If he has monopolistic powers he ignores the law. He says, 'Because I am big and great I will defy the law.'"

The Late Prof. Ludwig Boltzmann.

BY BROTHER POTAMIAN,

Professor of Physics, Manhattan College.

The name of Boltzmann is a household one with every student of physical theory and mathematical physics. He was a shining light in the scientific firmament, and to his published investigations many of us have turned time and again for inspiration and direction. During a long period of mental activity his name was intimately associated with every advance that was made in molecular theory. He championed with enthusiasm the electromagnetic theory of light to fully appreciate which he undertook, without any knowledge of English, to read Maxwell's papers on the subject with no other aid than that of a dictionary, a fact that shows his tenacity of purpose and immense capacity for work. Accustomed as we have been to look up to Boltzmann with the respect and reverence due to his great ability and remarkable achievements, the news of his death by his own hand gave a rude shock to our estimate and appreciation of the man. The thought brings with it no small degree of diffidence and melancholy, viz.: that it is possible to find united in one and the same person great mentality and great personal weakness. Trials and troubles, be they what they may, can never justify self-destruction. That philosopher was right who said that the noblest sight in this world is to see the valiant man battling with difficulties.

It is only a few years since Boltzmann celebrated with befitting festivity and ceremony the sixtieth anniversary of his birthday, on which occasion he received letters and telegrams of congratulation from all parts of the world. No less than one hundred and seventeen men of eminence contributed papers to the *Festschrift*. The sexagenarian was then in excellent spirits and there was nothing to forebode the sad and tragic event of Wednesday, September 5.

Boltzmann was born in Vienna February 20, 1844, and received his academical training in the celebrated schools on the banks of the Danube. The fame of Heidelberg and Berlin attracted him to their laboratories, where he devoted himself with ardor to research work. At the age of twenty-three we find him appointed lecturer in the university of his native city, from which he passed successively to Gratz, 1869; Vienna, 1873; Gratz, 1876; Munich, 1890; Vienna, 1895; Leipzig, 1900, and Vienna, 1902. Such a series of migrations is indicative of the state of unrest which accompanied Boltzmann through life. Indeed, he often twitted Stefan and Loschmidt, his fellow-professors, on their fixity and on their lack of the peripatetic spirit.

It was Stefan who discovered from experimental data the law that the energy radiated from a black surface is proportional to the fourth power of its absolute temperature, a law which Boltzmann showed in 1884 to be in strict conformity with the principles of thermodynamics.

Boltzmann's early investigations were connected with the great question of the seventies, viz.: the electromagnetic theory of light, put forward and advocated by Clerk Maxwell. If this law requires the velocity of propagation of an electromagnetic disturbance in a transparent medium to be that of light itself, it also requires that in non-magnetic media the specific inductive capacity (dielectric constant) should be equal to the square of the refractive index ($k = \mu^2$). It was first here that Boltzmann did splendid work in determining the dielectric constant of a number of substances, among which we may mention paraffin, ebonite, sulphur, glass, resin. Undeterred by the failures of others as well as by numerous inherent experimental difficulties, Boltzmann proceeded to find the dielectric constant of certain gases in which determinations he showed great resourcefulness and unremitting application in reaching the highest degree of accuracy attainable.

Boltzmann's work on the kinetic theory of gases as also on thermodynamics generally is of such importance as to secure recognition in all commendable text-books on advanced physics.

Though primarily a mathematician, Boltzmann had the talent of expounding physical theory with the ease and clearness of the French school of writers. From the German we have been led to expect ponderosity; from the Frenchman, lucidity. Boltz-

mann had the material of the former and the fluency of the latter.

To students Boltzmann is best known by his "Principles of Mechanics," and his "Lectures on the kinetic theory of gases and the electromagnetic theory of light." In his latest book, published in 1905, he writes on atoms, energy and scientific method; also on the work of his friends, Kirchoff, Stefan, Loschmidt. He approves of the views of Van't Hoff on osmotic pressures, but criticises unsparingly Ostwald's writings on energetics. In this same volume of *Populäre Schriften*, Boltzmann gives a lengthy and very readable account of his last visit to the United States, on which occasion he spent some time in the University of California. He shows himself throughout observant, critical and humorous. The *Populäre Schriften* deserves a translator, as it treats of many subjects that are of permanent interest to the general scientific reader.

New York Meeting of the American Electrochemical Society.

The tenth general meeting of the American Electrochemical Society, held in New York City on October 8 and 9, was somewhat in the nature of an experiment. It was found in former years that when an attempt was made to hold two large meetings a year that this was one too many. However, since the society furnishes to its members a volume of *Transactions* after each meeting it was not thought wise to entirely discontinue the practice of holding two meetings, since this would have involved the publication of one single volume of *Transactions* in a year.

As a compromise the following arrangement was then adopted for the present by the board of directors. There will be one general meeting in the spring of each year, the place of which will be determined upon from year to year. There will be a second smaller meeting in the autumn, and this will always be held in New York City, since it is thought that the large local New York membership will insure a good attendance, and further that many members who do not live in New York make in the autumn a professional trip to New York, and could combine this with attendance at the meeting.

In the present case the dates 8th and 9th of October were selected in order to enable those who would attend the Perkin celebration of the 50th anniversary of the Coal Tar Industry, also to attend the meeting.

While the dinner given by the chemists of the United States to Sir William Perkin, for his invention 50 years ago of the dyestuff mauve, whereby he became the founder of the now famous coal-tar industry, did not form a part of the proceedings of the American Electrochemical Society, yet this delightful occasion may be referred to here, since many members of the society attended it.

The dinner was held at Delmonico's on the evening of October 6. Prof. C. F. Chandler, of Columbia University, acted as toastmaster. Dr. W. H. Nichols, president of the General Chemical Company, and past-president of the Society of Chemical Industry, presented the first Perkin medal to Sir William Perkin himself, while Mr. Kuttroff presented him with a silver tea service as a token of esteem of the American chemists. Sir William thanked them in a felicitous speech.

After a meeting of the board of directors the first meeting was called to order by the president, Mr. Carl Hering, at 10 o'clock, in one of the electrochemical lecture rooms in Havemeyer Building of Columbia University. Prof. C. F. Chandler, of Columbia University, in a felicitous little speech, extended the welcome of Columbia University. He referred to various cases from practice showing how electrochemical methods have had the effect of simplifying metallurgical operations and saving the wear and tear on the human beings employed in the plant.

He referred to the bad feeling which generally arises in the older societies when a new society appears, but he said the more societies the better for the cause of science. Mr. Carl Hering thanked him in the name of the society.

CONCENTRATION CELLS.

The first paper on the programme was by Prof. Henry S. Carhart, on formulas for the concentration cell. In the absence of the author it was read by Prof. Bancroft. The author pointed out that if in a concentration cell the heat of reaction (that is the dilution heat) is zero, then Helmholtz's general equation for galvanic cells can be easily transformed into Nernst's formula for concentration cells. In this case the electrical energy is derived from the heat of the surroundings. The paper was briefly discussed by Mr. Hering and Prof. Bancroft.

MIGRATION OF PARTICLES BETWEEN ELECTRODES.

A paper by President Carl Hering was then presented on the visible migration of particles between electrodes. The paper dealt especially with microscopic researches made by the author in conjunction with Dr. E. F. Northrup, on the very interesting, curious and still unexplained Brownian movements, those persistent and untiring movements of minute lifeless bodies which are still, perhaps, the closest approach to perpetual motion yet observed. These small but molar particles were subjected to the influence of an electrical current in the surrounding liquid, or to charged electrodes in insulating liquids, and it was then noticed that they wandered across the field from one electrode to another. Their motion was very decided; it was along the lines joining the electrodes, that is, from one electrode to the other, showing that they were attracted by one or the other electrode. Some traveled with the current, others in the opposite direction, but each particle had its characteristic direction of motion. In some mixtures of particles of different materials, those of one kind traveled with the current, and those of the other against it. In some cases an extremely small current or difference of potential was sufficient to move them. These motions were so positively related to the electric conditions that the idea was suggested to Dr. Northrup of making it the basis of a successful electric measuring instrument for special purposes. These observations were used by the author as the basis for explaining some peculiar effects sometimes observed in electrolysis.

The paper elicited considerable discussion. Prof. Bancroft thought that Mr. Hering has watched under the microscope what is the reverse of electric endosmosis. There is always a relative motion of a liquid and diaphragm. Whatever is movable moves. In electric endosmosis the diaphragm is stationary and the liquid moves bodily. In Mr. Hering's experiments the liquid is stationary and the colloidal particles in it move. Mr. Hering then referred to the beneficial effect which the addition of some colloids has on the production of a smooth, compact electrolytic metallic deposit. According to a recent patent of an engineer of the Siemens-Halske Company this is due to the formation of a protective colloidal diaphragm at such places where otherwise trees would form, so that on the whole a smooth deposit is obtained. For this reason only such colloids are useful which travel with the current towards the cathode. Reference was made by Mr. Sperry to the successful employment of a small quantity of glue in the electrolytic lead refining process of Betts.

LABORATORY APPLIANCES.

Mr. S. S. Sadtler then described some simple laboratory applications for electric fusion and other work. The current used by him was from the city lighting service, which is on the 2 × 110-volt, three-wire system. For varying the current a bank of lamps was employed. For small fusion experiments he used a small gas burner arrangement, for large experiments a dental furnace with a large gas blast lamp or gasoline lamp.

In some of the author's experiments in which certain gases were passed over a solid at a definite temperature, an electric tube furnace was found very effective. It consisted essentially of a long porcelain tube, around which platinum wire was wound.

As a convenient rheostat the author used a set of small discs of carbon, the resistance of which is varied by adjusting the pressure by means of a screw.

COPPER CATHODES IN NITRIC ACID.

A paper by J. W. Turrentine on this subject was read, in the absence of the author, by Prof. Bancroft. It is known that nitric acid in dilute solutions undergoes reduction, quantitatively, at the cathode. Nitric acid in acting on copper, on the other

hand, is reduced not to ammonia, but to nitric oxide, as indicated by a free evolution of brown fumes. This is an apparent contradiction to Bancroft's general law of the parallelism between electrochemical and purely chemical action. The author showed, however, that this apparent discrepancy is due entirely to a difference in the conditions under which the two sets of reactions are performed.

ALUMINUM-MAGNESIUM CELL.

A paper by G. H. Cole and H. T. Barnes, on an aluminum-magnesium cell, was read in the absence of the authors in abstract by Prof. Bancroft. The cell has an aluminum and a magnesium electrode and potassium alum as electrolyte, to which either hydrogen peroxide is added or oxygen is bubbled through. Under these conditions an e.m.f. of 2 volts is fairly well maintained. This is peculiar since aluminum and magnesium are two metals standing so near together. Prof. Loeb suggested in the discussion that the cell might be essentially a gas cell.

MELTING POINTS.

A paper by F. R. Pyne dealt with a determination of melting points of some cryolite-alumina mixtures, which subject is of importance for the production of alumina. Pure cryolite has a melting point of 1,000° C. The addition of alumina lowers the melting point until it is 915° for a mixture of 95 per cent cryolite and 5 per cent alumina. The melting point then rises again and is 1,015° C. for a mixture of 80 per cent. cryolite and 20 per cent alumina.

ZINC CHLORIDE FROM SULPHATE.

A paper by P. B. Sadtler and W. H. Walker dealt with the double decomposition of zinc sulphate and sodium chloride. The object is to change zinc sulphate cheaply into zinc chloride. This is accomplished with the use of saturated solutions of common salt and zinc sulphate. Chilling to a certain point results in the crystallation of glauber salt, leaving zinc chloride. The theory of the process is based on the phase rule.

DISTRIBUTION LAW.

The last paper of the Monday session was by Dr. H. E. Patten on some factors affecting the distribution law and referred especially to the quantity of dye absorbed by quartz powder.

Prof. S. A. Tucker, of Columbia University, was the courteous guide through the newly equipped electrochemical laboratories in his charge, in the basement of Havemeyer Hall. The equipment is up-to-date and very complete.

ULTRA-VIOLET LIGHT.

In the afternoon the members visited the College of the City of New York, where Dr. Charles Baskerville lectured on the use of ultra-violet light in the laboratory and in practice. The chief points were the influence of ultra-violet light on fluorescent and luminescent bodies; a very interesting application to metallurgy was described.

After that Dr. Elliott took the members to the Waterside Station of the Edison Company, where the visitors were enabled to see the station at its busiest time, namely, when the evening load was coming on. In the evening a subscription dinner was served in the hall of the Liederkranz Society. Mr. H. B. Coho distinguished himself again as toastmaster, while President Hering, Dr. Elliott and Mr. Morehead made speeches.

PYROMETRY.

The first part of the Tuesday session, held in Havemeyer Hall, was devoted to a symposium on pyrometry. An introductory speech was made by Dr. E. F. Roeber, who first referred to the difficulty of defining concisely temperature. The only way of giving a definition of temperature which is independent of any arbitrary thermometric substance, is on the basis of the second principle of thermodynamics. We know how to establish this absolute thermodynamic scale, but we have not yet done it. While this represents a limit of our knowledge, the speaker emphasized the enormous progress which has been made in the last years in the practical application of thermometers and pyrometers. There is at present a pyrometer boom, which seems destined to last. In chemical and metallurgical processes the manufacturer formerly depended upon the eye of the working man in order to keep the temperature at the right point. With such methods all the knowledge of the thermometry of the process was locked up in the workingman, and when the latter left the plant his knowledge went with him. If, however, pyrometers are used, one has a written record which can be duplicated at any time.

Recording pyrometers enable one to control the attendants, but they are nevertheless liked by the workingman since they are a help and guide to him. It is the same with carbon dioxide recorders, which have proven very useful, for instance in the power station of the New York Subway.

Mr. F. F. Schuetz then presented a paper on the Bristol thermo-electric pyrometer. The paper was illustrated by many experiments, and the new recording pyrometer of Prof. Bristol was also shown in operation.

Mr. R. S. Whipple, of Cambridge, England, then spoke in a very interesting way on the progress of pyrometry in Europe. To keep the cold joint of a thermo-couple at a constant temperature he recommends the use of some steam, which is always available in a plant. With the careless method used at present in many plants, considerable error can arise, due to changes of temperature of the cold end. He then described the three pyrometers which he exhibited, one being an electric resistance pyrometer with the Whipple indicator, the second an electric resistance pyrometer with a Calendar recorder, and the last a Fery radiation pyrometer. The author showed some interesting slides from pyrometric practice.

Dr. Moldenke, secretary of the American Foundryman's Association, then spoke on the use of pyrometers in foundry practice, with special reference to the Le Chatelier thermo-electric pyrometer of the Heraeus type, which was also exhibited.

He was followed by Mr. Brown, who showed two pyrometers; one of them a recording pyrometer used specially for measuring hot blast, is based on measuring the difference of expansion of a steel tubing containing a graphite rod. The second pyrometer exhibited by him was what he calls the "quick-acting platinum pyrometer," which has a thin strip of platinum hung between heavy iron frames. When the end of the stem of the instrument is inserted in the blast the thin platinum strip quickly heats up to the temperature of the atmosphere, whilst the heavy iron frame is very slow in heating up. The platinum strip acts on the pointer and the maximum deviation of the pointer gives the temperature.

Mr. S. S. Sadtler described the Price thermo-electric pyrometer, which was also exhibited.

After the meeting Mr. Wilson made a very interesting experiment, on the determination of the temperature of a gas-heated muffle furnace, both with an electric resistance pyrometer and with a Fery radiation pyrometer. The latter enables one to measure the temperature from a distance and is based on the Stefan-Boltzmann law of the total radiation. This experiment showed that the two instruments, which are so different in type, register the same value for the temperature.

PRIMARY BATTERY.

The last paper of the meeting was presented by Prof. F. B. Crocker, on the Decker primary battery. This paper is published in full on another page of this issue. It was discussed by Messrs. Sperry and Tucker, who asked various questions.

After a vote of thanks proposed by Mr. Morehead the meeting adjourned.

In the afternoon an excursion was made to the Maurer plant of the American Smelting & Refining Company, near Perth Amboy, N. J., where the large electrolytic copper refinery was inspected.

In the evening the members attended the reception given to Sir William Perkin at the Chemists' Club. Prof. M. T. Bogert, of Columbia, expressed the encouragement and inspiration American chemists had received in meeting Sir William face to face, and Prof. M. Loeb, of New York University, referred to the strictures passed in the pure-food discussion upon the use of aniline dyes in the preparation of foods.

"In the spring," he said, "they objected to the fat of our sausages. Now they are finding fault with the lean."

After short speeches by Dr. William McMurrie and Dr. Maximilian Toch, Sir William Perkin replied. He expressed his

great gratification at the reception accorded him and told how he had been a pupil of the great Faraday. He traced his own scientific descent from him.

"You hardly realize," he said, "the difficulties with which we had to contend. It was Faraday who discovered benzine, and I used benzine with nitric acid to produce mauve. But it was not easy in those days to procure nitric acid. I had to take sodium of nitrate and sulphuric acid and mix them together. It required a good deal of experimenting to hit upon the right proportions. Then I added benzine, and from this I got nitrobenzine, from which came the aniline dye."

Municipal Ownership and Taxation in Scotland.

United States Consul Rufus Fleming, of Edinburgh, quotes from the Scottish taxation returns for the financial year 1904, which shows that the total amount of debt of local authorities outstanding at the close of the year was $288,656,146, an increase of $13,832,763 over the local indebtedness at the end of the previous financial year. It appears also that local rates or taxes have been steadily rising. In 1893-4 the average rate of assessment per pound sterling of gross rental was 72.1 cents; in 1903-4 it was 93.4 cents, an increase in ten years of about 29.5 per cent. During the same period the local taxation per capita rose from $4.281 to $6.0865—about 42.2 per cent. The increase of assessments has been due mainly to higher rates for purposes of education, sanitation, water supply and roads.

An interesting feature of the report is a statement of the revenue and expenditure of local authorities from and on revenue-producing undertakings—in other words, public utilities owned and operated by town councils or other public bodies. In the following table, taken from the returns, expenditure includes payments for redemption of debt and depreciation when special provision is made for that purpose:

Undertakings.	Revenue.	Expenditure.
Gas supply (exclusive of public lighting)	$8,484,801	$8,608,877
Electricity supply (exc. of public lighting)	1,871,140	1,772,822
Tramways	4,564,159	4,189,035
Light railways	1,051	14,147
Water supply	1,956,640	4,295,163
Telephones	241,622	223,854
Markets	241,135	174,795
Slaughterhouses	189,701	187,492
Public baths and washhouses	174,503	314,697
Private improvement expenses	219,453	215,406
Working-class dwellings	341,453	503,313
Working-class lodging houses	123,940	111,404
Burial grounds	180,670	364,452
Harbors and ports	5,158,432	5,145,210
Total	$23,748,700	$26,120,671

Only electricity, tramways, telephones, markets and two or three other undertakings have yielded an excess of revenue over expenditure. In connection with the above significant statistics it may be useful to consider the rate of taxation in the seven principal cities of Scotland.

City.	Local taxes per $4.86 of gross rental. Cents.	City.	Local taxes per $4.86 of gross rental. Cents.
Glasgow	99.6	Leith	75.7
Edinburgh	76.7	Paisley	108.9
Aberdeen	97.4	Greenock	87.6
Dundee	83.0		

In Glasgow, Aberdeen and Paisley local taxation exceeds the average rate for the whole of Scotland. It is noteworthy that these three cities have been specially enterprising in the matter of municipal trading. The conclusion seems unavoidable that whatever benefits municipal ownership of public utilities may have bestowed upon the masses, it has not tended to lighten the burdens of taxpayers.

Old Time Telegraphers in Convention.

At Washington on October 9 the twenty-sixth annual convention of the Old-Time Telegraphers and Historical Association and the Society of the United States Military Telegraphers was held. The delegates are from all parts of the United States and Canada. The president, Mr. William H. Young, was roundly applauded when he called the convention to order. In a few appropriate remarks he introduced Mr. H. B. F. Macfarland, president of the Board of District Commissioners, who welcomed the delegates to Washington. The response was delivered by Mr. William J. Dealy, of New York.

In his address President Young recommended that certain changes be made in the policy and plans of the organization and submitted for the consideration of the convention the suggestion that hereafter each member of the association pay his proportionate share of the expense of the meetings. He then read an interesting statement prepared by Dr. James J. Clark, of Washington, D. C., at one time associated with Morse, on the first telegraphic message from Washington to Baltimore, together with a history of the first steps taken to perfect the art. Additional interest was lent to the paper by the announcement that Dr. Clark constructed the first repeater and the first relays to be used as sounders.

The treasurer and secretary gave satisfactory reports on finances and membership. Niagara Falls was selected as the place of meeting next year; the date to be selected by the local executive committee. The following officers were elected: President, Harvey D. Reynolds, superintendent Postal Telegraph Company, Buffalo, N. Y.; first vice-president, George A. Burnett, superintendent Great Northwestern Telegraph Company, Buffalo, N. Y.; second vice-president, I. McMichael, general superintendent Great Northwestern Telegraph Company, Toronto; third vice-president, George F. McDonald, superintendent Great Northern Telegraph Company, of Ottawa, Canada. Executive Committee—William H. Young, Washington, D. C.; J. C. Barclay and Charles C. Adams, New York, all former presidents of the association; Hugh J. Fry, Milwaukee, and three others to be named by the president.

CURRENT NEWS AND NOTES.

PENNSYLVANIA TUBES.—The second Pennsylvania Railroad tube between Manhattan Island and New Jersey is finished and was visited this week, on Tuesday, by a large party of engineers, and the officials of the road. One interesting and amusing feature of the decorations under the Hudson was a large electric sign of "Welcome."

FORT DESTROYED BY LIGHTNING.—The French papers make note of the destruction of a fort by lightning at Besancon, where there was an important magazine full of gunpowder and melinite. Foundations torn as though by an earthquake and a bent and dinted steel turret were all that was left of what was one of the strongest works on the eastern French frontier. The roads and fields for three-quarters of a mile round were strewn with the débris. All windows of houses within several miles were shattered. The non-commissioned officer in command, the resident sergeant and his wife and daughter, three soldiers, a sister of one of the soldiers on a visit, and a peasant working in the fields near by were killed. The fort was almost new. The old one which it replaced was accidentally destroyed by dynamite in 1874.

ELECTRICITY ON A STEAMER.—The steamship *Moultan*, plying between England and India, is lavishly equipped electrically throughout, and has a variety of new methods of application. In the large dining-rooms, smoking-rooms and cabins air fans are continuously at work. In the first-class saloon there are no fewer than thirty-five fans, which take the place of the old hand swung punkahs. In the cooks' galley the huge sides and joints of meat are cooked on spits driven by motor. There are three of them in one great oven, and each is controlled independently. In another apartment is an electric plate washing machine, cleaning about 1,000 plates per hour. The water is forced on to the soiled plates, which, after being cleansed, are rinsed in water of so high a temperature that on being taken out they dry immediately. This is necessary when it is considered that 7,200 plates are used for each meal, when the full complement of 600 passengers is aboard.

EMPIRE STATE CONVENTION.—The Empire State Gas and Electric Association will hold its annual convention at the Hotel Astor, New York City, on Friday, October 12, when a number of interesting topics will be discussed, including municipal ownership.

INDEPENDENT TELEPHONE MERGER.—It is announced from Pittsburg that with a capital of $25,000,000 the American Union Telephone Company, of Pennsylvania, has taken over fifteen independent telephone companies in this State, Southern New York, Eastern Ohio, Maryland and West Virginia, and has made arrangements with other independent companies for a long-distance service covering one-third of the United States. The merger of these companies and arrangements with other companies for long-distance service were perfected largely by H. Prentiss Taylor, of Pittsburg.

ILLUMINATING ENGINEERING FOR CARNEGIE LIBRARIES.—Messrs. Carrère & Hastings, McKim, Mead & White and Babb, Cook & Willard, the advisory architects for Mr. Carnegie, have retained Mr. L. B. Marks as consulting engineer in illumination for the library buildings which Mr. Carnegie is building for New York City's public library system. The total number of these buildings will exceed fifty. This recognition of illuminating engineering as a specialty by architects of national standing, should go far toward permanently establishing the status of the illuminating engineer.

WIRELESS ON THE ATLANTIC.—A cable dispatch from Berlin of October 6 says: "The Berlin Company for Wireless Telegraphy has just received a cable dispatch from the Nord Deutscher Lloyd steamship *Bremen* informing it that the steamship had understood the messages sent by the Telefunken system from the German station at Naum when the vessel was 2,000 km. (1,250 miles) out at sea. The result is more remarkable as the messages traveled half the distance overland. German scientists now state that in future ships will be able to receive New York dispatches during their entire westbound voyage independent of the Marconi system." The Old Dominion Line has closed negotiations with the Atlantic De Forest Wireless Company for the installation of the wireless system on steamers *Hamilton, Princess Anne, Jamestown* and *Jefferson*, plying between New York and Norfolk. The apparatus will be placed on board the ships immediately.

WIRES IN WASHINGTON.—According to the annual report of the electrical engineer, Walter C. Allen, of the District of Columbia, the expenditures of all branches of the electrical department during the twelve months ended June 30, 1906, aggregated $341,864. Within the year the department's system of underground wires was increased by the laying of nearly ten miles of new cables, containing more than 150 miles of wires; the number of fire alarm boxes was increased from 392 to 416, and through these boxes a total of 565 fire alarms were received. Added to the number of local, second, third, automatic and telephone alarms, it is shown that the fire department received a total of 1,006 alarms during the year. With additions made last year the report shows that a total of 316 telephones are now connected to the system. One of the interesting statements in the report has to do with the number of poles of all kinds still standing in the District, the total at the beginning of the new fiscal year on July 1 being 12,960. Of this number the Chesapeake & Potomac Telephone Company with 5,325 has nearly one-half, the Potomac Electric Power Company 1,909, the Western Union Telegraph Company 1,397 and the District government 794. The lighting service of the city was increased by the addition of 163 lamps of all kinds, a total of 320 new lamps having been erected and lighted, while 157 were discontinued. The total of lamps in use on July 1, 1905, was 11,247, and on July 1, 1906, 11,410.

EFFECT OF LOW STEAM FARES.—It would appear that the 2-cents-a-mile rate enacted for Ohio steam roads by the last State Legislature is not working to the disadvantage of the electric roads, but rather otherwise. At first the electric railway operators, according to the *Street Railway Journal*, feared that they would lose much of their business on the longer trips because the difference in fare was no longer greatly to the advantage of the electrics. One of the most advantageous instances for studying this effect was that of the Lake Shore Electric Railway on its 120 miles from Cleveland to Toledo. The electric line charged $1.75 for the one-way trip, while the steam road rate under the old conditions was $3.20. The 2-cents-a-mile law cut the steam rate to $2.15, or a difference of only 40 cents, where formerly it was $1.45. But the trolley company held its ground, and instead of cutting rates it improved the service by cutting off fifteen minutes from the running time by putting on two additional limiteds each way and installing new cars for the service. Figures now given out by the company demonstrate that this policy was the right one and that the steam reduction was not sufficient to get the business in the face of fast and regular service and the advantage of landing in the center of the business district of the large city. It is stated that where a year ago with three limiteds each way the cars were averaging 40 cents a car-mile, with five limiteds at present they are earning 50 cents a car-mile.

PATENT OFFICE CONGESTION.—A startling exhibit of Patent Office congestion is furnished in figures compiled recently by Mr. F. W. Barnaclo, of New York City. The office seems sorely in need of more men at better pay, for which the annual profits seem quite adequate. Mr. Barnaclo's investigation shows that in January last there were 17,353 applications awaiting action in the 39 divisions of the Patent Office. To date there are 24,000 cases on the docket which have not been reached for examination, and tabulations prepared by the attorney show that the office is falling behind from 250 to 300 cases a week. It is shown in the records that the average number of applications filed a week is from 800 to 1,200, and there are only about 600 patents issued a week. Among divisions behind are the following: Hydraulic motors, pumps and sewerage appliances, 11 months and 23 days behind and 1,029 cases on hand. Air and gas engines, pumps and pneumatics, 10 months behind and 993 cases on hand. Machine tools, 7 months and 19 days behind and 675 cases on hand. Elevators, journal boxes, lubricators, machine elements, pulleys and shafting, 4 months and 17 days behind and 657 cases on hand. Annealing, tempering and coating in metals, electrochemicals, metal founding, metallurgy, etc., 3 months behind and 375 cases on hand. Electric conductors, electric appliances, lighting, etc., 11 months and 7 days behind and 1,069 cases on hand. Steam engineering, 4 months and 23 days behind and 472 cases on hand. Motive power, 5 months and 25 days behind and 613 cases on hand.

MACHINE SHOP PRODUCTS.—The United States Bureau of the Census has compiled the returns of 1905 covering the manufacture of foundry and machine shop products in the United States and in the ten leading States in the order of their output. From these figures it appears that in 1905 there were 8,993 establishments with a capital of $845,024,825, as compared with 9,324 establishments having a capital of $665,058,205 in 1900. The item of capital includes live assets only and bears no relation to issues of stocks and bonds. There were 348,381 wage earners, receiving $196,247,413 in wages in 1905, against 350,327, receiving $182,232,009 in 1900. The miscellaneous expenses of the industry in 1905 were $70,094,411, as compared with $41,103,995 in 1900. The materials consumed in 1905 were valued at $278,074,203, against $286,357,107 in 1900, while the total value of the product of the industry in 1905 was $685,901,388, compared with $644,990,999. Pennsylvania returned the largest total product in 1905, amounting to $112,856,748, a loss of nearly $15,000,000 as compared with 1900, when the total was $127,292,440. In 1905 the establishments numbered 1,182, as compared with 1,260 in 1900, and the capital was returned at $169,646,734, as compared with $154,958,750. There was a decline in the number of wage earners from 62,828 to 56,853, and in wages paid from $33,199,521 to $31,231,113. The item of miscellaneous expenses increased from $6,830,037 to $10,995,027, but the cost of materials declined from $62,336,770 to $48,149,886. New York still holds second place, but the product shows a decline from $96,636,517 to $91,432,923. Ohio, which reported a product valued at $72,399,632 in 1900, has made a large gain. Massachusetts also showed a decline. All the Western States showed gains.

AFFAIRS IN CUBA.—In view of the present condition of affairs in Cuba, it is interesting to note that in the fiscal year, 1906, the island imported from the United States $528,565 of electrical machinery, $658,684 of scientific instruments and $701,637 of steam engines.

WIRELESS FOR BOSTON STEAMERS.—The Merchants and Miners Transportation Company has completed negotiations with the Atlantic De Forest Wireless Company for wireless telegraphy on their Boston steamers. The steamer "Gloucester" will be equipped immediately.

RAILWAY SIGNAL ASSOCIATION.—The Railway Signal Association is to meet at the New Willard Hotel, Washington, D. C., on October 16, 17 and 18, for its annual meeting. The original plan was for a week earlier, but two other large conventions at the national capital were in the way.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS.—The annual meeting of the Western Association of Electrical Inspectors will be held in the assembly room of the Denison Hotel, Indianapolis, Ind., October 17, 18 and 19, 1906. Mr. William S. Boyd, 382 Ohio Street, Chicago, is secretary.

LAMPS FREE IN DAYTON, OHIO.—In a recent issue of *Dayton Electricity*, published by the Dayton Lighting Company, the announcement is made that the company will furnish Nernst lamps in its alternating-current district and Gem lamps in its direct-current district free of charge, and will maintain them free just as it does incandescent lamps. The results of such a liberal policy in management should be good and deserve watching and recording.

WIRELESS IN HAWAII.—A special telegram from Vallejo, Cal., of October 2 reports that Mr. George Hanscom, chief electrician of the Mare Island Navy Yard, has returned from the Farralones with his force of men, where a wireless plant sixteen times more powerful than the old one, has been installed. Great hopes are entertained of getting connection with Honolulu. Four men were left in charge and the result of tests soon to be made is awaited with interest.

TELEPHONY AT BRIGHTON.—The municipality of Brighton, England, the famous seaside resort on the south coast, has sold its telephone exchange to the Government. The plant had cost $263,590 and was sold for $18,590 less. This repeats the history of the Glasgow municipal exchange. At Brighton the system of the National Telephone Company had considerably more than twice as many subscribers as the municipal exchange, and this after being at a standstill for some time had lately begun to lose its patrons rapidly.

NATURAL GAS IN INDIANA.—Natural gas in many localities in Indiana is a thing of the past. The gas companies have miles and miles of mains in the ground, and are also the owners of valuable franchises. Whether these mains will be used later on to carry artificial gas is a matter of conjecture. For fourteen years most of the citizens of the favored territory used natural gas, which proved to be the finest of fuels. In many cities they are using artificial gas for cooking, and it is said that many of the Indiana natural gas plants will be used for distributing artificial gas, and this is why they place a big value on their mains and franchises.

EAST ORANGE (N. J.) MUNICIPAL PLANT.—The municipal authorities of East Orange, N. J., have been for some time considering the installation of an electric light plant, and some weeks ago the lighting committee was authorized to employ an expert to make up an estimate and submit figures as to the cost of such a plant. Mr. Henry Floy has been retained as consulting engineer and will in the near future submit a report covering the lighting question. His report will also include a statement as to the possibilities of utilizing for the generation of electricity the heat to be generated in a proposed incinerator for destroying city refuse, along lines successfully carried out in Europe. Mr. L. B. Marks will co-operate with Mr. Floy on the question of illumination. At the present time the streets of the city are lighted by Welsbach gas lamps.

THE BERLIN CONFERENCE.—A special dispatch from Berlin of September 20, makes reference as follows to some of the aspects of the wireless conference there: "Mr. Marconi will be present at the sessions of the International Wireless Conference, which is to open here October 3, as a delegate from Montenegro. As the operations of his company will be one of the main subjects of controversy, his participation in the proceedings is likely to add to their interest. Another delegate will be Sunkichi Kimura, who is accused by the Slaby-Arco Company of having appropriated the general Slaby-Arco ideas for the Japanese Government, the same thing that the Marconi Company says the Slaby-Arco Company did with the Marconi inventions. Thirty-one out of thirty-three Governments invited to representation in the conference have accepted, China and Peru declining on the ground that they had no suitable representatives to send."

ELECTRIC SERVICE ON MANHATTAN.—The electric equipment and service of Manhattan Island continues to grow at an increasing rate. During the twelve months ending August 31st the net increase is 9,566 consumers, having an aggregate installation of 866,400 16-cp equivalents; 128,399 hp in Edison motors are now used, and the installations, all taken together, aggregate 4,319,261 equivalents of 16 candles. Electric heating and cooking appliances are becoming increasingly popular. During the month of August 152 kw of these appliances were connected with the mains of the New York Edison Company. This is the equivalent of more than 3,000 incandescent lamps of 16 candles. The amount may not seem large compared with the general growth, which, during the month of August, was equal to 94,945 16-candle incandescent lamps; but it is most suggestive when taken in connection with this particular department of electric service.

WIRELESS TRAIN TELEGRAPHY.—United States Consul E. L. Harris, of Chemnitz, writes that he has received numerous inquiries in regard to a short report made by him several months ago on the introduction of wireless telegraphy on railway trains in Germany, intended to lessen the danger of accidents. The information upon which the consul's report was based was taken from a Chemnitz newspaper. He says that no further information than was contained in his report could be obtained from the Saxon railway officials, and adds: "The last issue of the Berlin *Woche* contains an illustrated article which shows that experiments are being carried on quite extensively on the Berlin-Zossen line with results which are in favor of an early adoption of wireless systems on many of the State railways. I would advise those interested in securing detailed information concerning the progress of these experiments to address a letter of inquiry to Zimmerstrasse 37-41, Berlin, and it is not improbable that the writer may eventually be put in touch with the officials having charge of the matter."

FLATIRONS AND DIGNITY.—Why it should be undignified to offer electric flatirons as "premiums," we don't exactly see, but the following from London *Electrical Industries* may illuminate the point: "It appears that American companies have more than one way of introducing the flatiron into the home. The Spokane *Evening Chronicle*, we learn from the Electrical World, offers an electric flatiron as a premium in connection with a subscription to that journal. Every old or new subscriber who agrees to take the newspaper at the regular rate of 10 cents a week for the paper and five cents additional for the electric iron, can secure the iron by calling at the *Chronicle's* premium department. The Washington Water Power Company, of Spokane, furnishes the irons to the newspaper at $3 each. The *Chronicle* is now selling them at the rate of fifty per day, and has already sold (within the last seven months) over 2,000. The demand is not equal to the supply. Evidently this bold advertising plan works very well in America, but it is a question whether such 'given away with *Tit-Bits*' ideas would suit the British householder. Certainly they would not suit the retiring dignity of the British electricity supply undertaking."

Electrical Equipments of the Columbus City and Interurban Railway Systems.

UNTIL July 1 of the present year the entire street railway system in the city of Columbus was operated by two independent companies, namely, the Columbus Railway & Light Company and the Central Market Street Railway Company. Since the date noted, however, the first-named company has been operating the Central Market system for the owners. The operating company owns about 300 cars of various designs and dimensions. With only a few exceptions each car is provided with two motors. There has recently been worked out an ingenious method for running the cars in trains in order to lessen the congestion on the principal streets, as well as to increase the carrying capacity in rush hours. The first car of each train is provided with a multiple-unit controller of the regular type employed for four motors. The wiring of this controller is identical with that of an ordinary four-motor equipment, with the exception that the leads for motors No. 3 and No. 4, instead of going to motors, are divided into a bus line extending the full length of the car and terminate in receptacles on each dash. On the rear car wires leading from the receptacle on the dashes are tapped in on the motor leads, and other than this addition no changes from the usual two-motor controller wiring is made. The chief advantage of the use of the two different kinds of controllers is that the extra expense of installing a multiple-unit controller on the rear car is avoided.

The Columbus Railway & Light Company has four distinct electric power services, namely, 550-580-volt, direct current for railway purposes, 115-230-volt direct current for Edison lighting system, 4,100-volt alternating current for lighting, and an independent insulated 550-volt power supply. The company owns four power houses, namely, Spring Street, known as Station No. 1; Gay Street, known as Station No. 2; Milo, known as Station No. 3, and a station formerly owned by the Central Market system, known as Station No. 4.

Most of the electricity for railway purposes is generated at Spring Street. Most of the electricity for lighting is generated at Gay Street. The generating apparatus at the Milo station is now held in reserve and is used only on peaks and in emergencies, a 500-kw National motor-generator set having been installed at this station for the purpose of taking current from the other stations and delivering direct current to the system in this district.

All of these stations are thoroughly tied together by alternating and direct-current tie lines, giving the greatest degree of flexibility and permitting of a number of combinations in the generation of electricity that assure economy and efficiency in the power supply and practically preclude the possibility of interruption to the railway, lighting or power service, through failure of lines or apparatus at any station.

FIG. 2.—INTERIOR OF SPRINGFIELD STREET STATION OF COLUMBUS RAILWAY & LIGHT COMPANY.

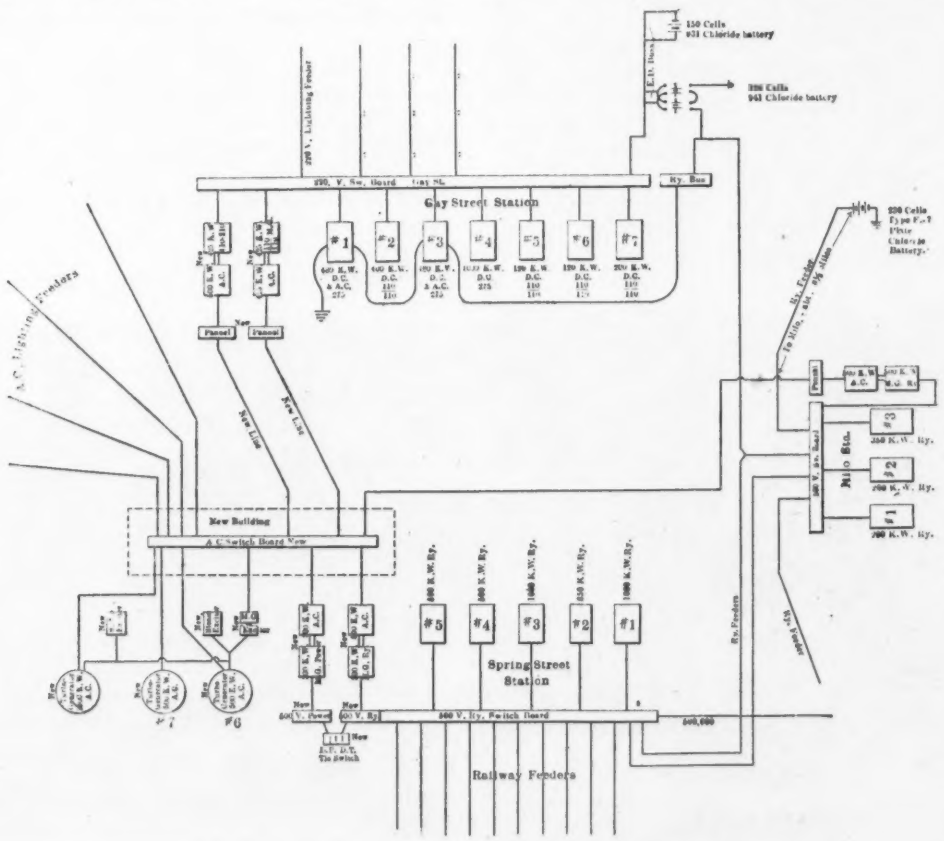


FIG. 1.—SCHEMATIC DIAGRAM OF STATION EQUIPMENTS OF COLUMBUS RAILWAY & LIGHT COMPANY.

As will be seen from the diagram of Fig. 1, the Spring Street station contains five railway units, two of which are 500-kw, two are 1,000-kw and one is a 840-kw unit. These machines handle the bulk of the railway load. There are also in this station two 500-kw Curtis turbo-generator sets which deliver alter-

nating current at 4,100 volts. There is room for an additional 1,500-kw turbo-generator set. The high degree of flexibility previously referred to is greatly increased by the use of motor-generator sets in the various stations. In the Spring Street station there is one 500-kw General Electric motor-generator set and one 300-kw General Electric motor-generator set, which can be used either to deliver railway current to the railway feeders or alternating current to the lighting system, as conditions may require. There is also one 150-kw General Electric booster set, which can be so connected as to boost through any feeder panel at this station. This booster is used chiefly on the park lines in summer. The railway units at this station are driven by Green-Wheelock engines.

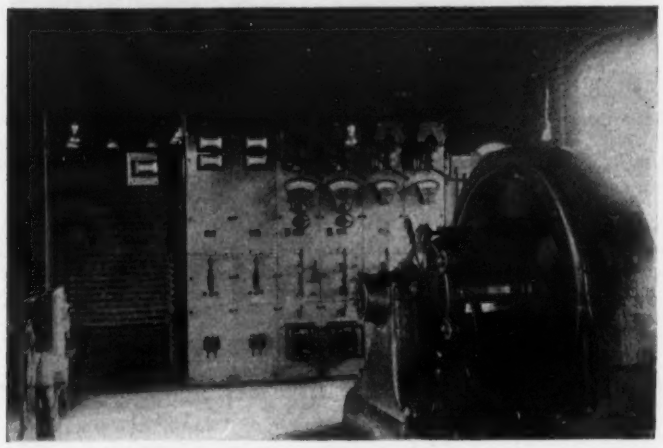


FIG. 3.—INTERIOR PLEASANT VALLEY SUB-STATION, COLUMBUS, NEWARK & ZANESVILLE.

The Gay Street station contains the following generating apparatus: Two 480-kw General Electric double-current machines, which can be used to deliver either direct or alternating current as required; one 400-kw General Electric 110-volt, direct-current machine and one 1,000-kw General Electric, 375-volt, direct-current machine for supplying electricity for the Edison lighting system. There are also three other units, two of them consisting of two 60-kw Edison bipolar machines and one consisting of two 100-kw Edison bipolar machines for use on the Edison system.

sets can, of course, be reversed so as to take direct current and deliver alternating current.

To further increase the flexibility and efficiency of the power supply there have been installed at the Gay Street station two storage batteries, one comprising a 320-cell "Chloride Accumulator" battery, which may be used to deliver electrical energy at either 550 volts to the railway or 220 volts to the Edison lighting system. This is accomplished by operating the cells in series for railway work and in parallel sections for lighting. The battery in railway work has a capacity of 880 kw. There is also a smaller battery, consisting of 150 cells, used on the Edison lighting system and supplied by one 50-kw, two-unit motor-generator set. The possibilities that lie in this combination of direct-current and alternating-current generating apparatus, motor-generator sets and storage batteries in securing any kind of current required, smoothing out peaks, and, at the same time, maintaining a good load factor on all machines, will be very evident.

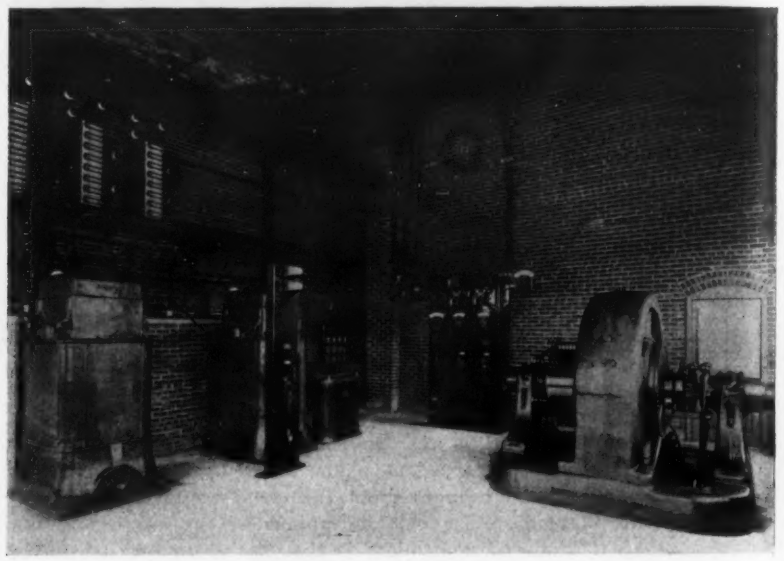


FIG. 5.—INTERIOR CHASELAND SUB-STATION, COLUMBUS, DELAWARE & MARION.

As stated, at the Milo station, the generating apparatus, which consists of two 200-kw and one 400-kw railway generators, is held in reserve, and the station is used principally as a sub-station, there having been installed a 500-kw motor-generator set supplied by the National Brake & Electric Company. This set is of the three-bearing type, and consists of a 750-hp, three-phase, 60-cycle synchronous motor receiving current at 4,100 volts and

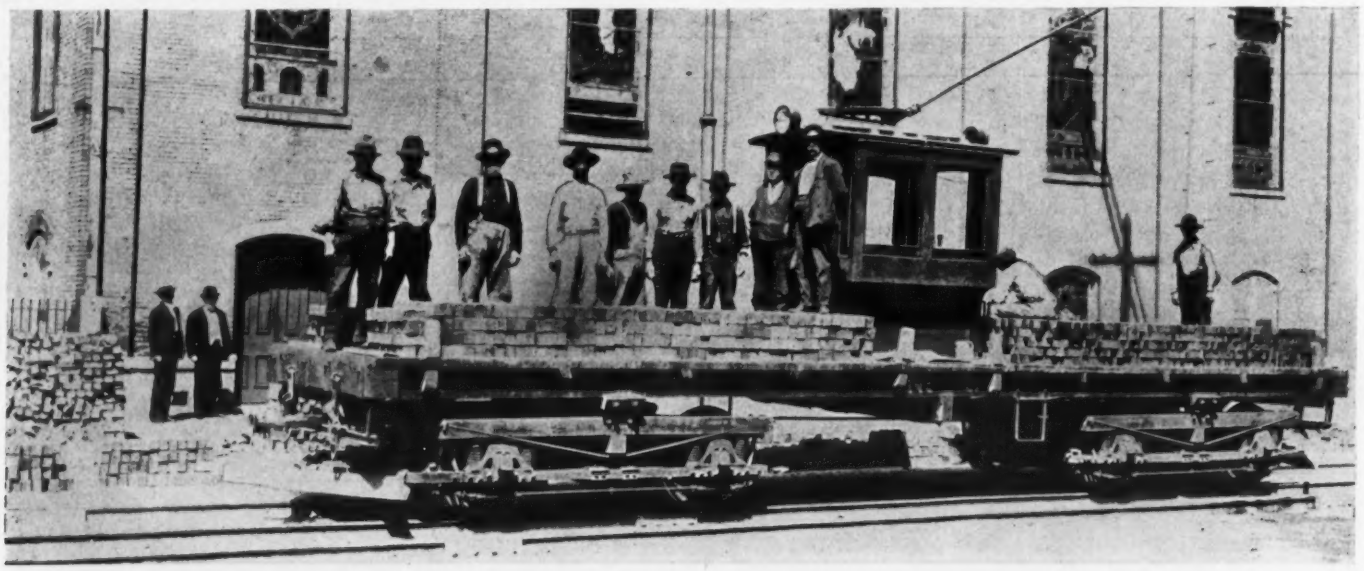


FIG. 4.—DELIVERING BRICK WITH RAIL CAR FOR PAVING BETWEEN TRACKS IN COLUMBUS.

In addition to the generating apparatus at this station there is one 500-kw, three-unit General Electric motor-generator set, the motor taking alternating current and driving the other two machines as generators, delivering 125-250 direct current to the Edison system. There is also one 500-kw General Electric two-unit motor-generator set, which is used in the same way. These

driving a 500-kw, direct-current generator, which generates current at 575 volts and 870 amp. This motor-generator set supplies the nearby territory and also feeds the line to Westerville. To improve the power situation on this Westerville line there is a 230-cell storage battery located about 8½ miles from Milo station, and which is used as a floating battery on the line.

The apparatus in the Central Market station consists of two 325-kw and one 250-kw Westinghouse railway generators. There is also at this station a 240-kw storage battery, which is fed from a motor booster set, and is used for taking care of load fluctuations at this power house.

In addition to the local electric railway system outlined above, which gives Columbus an unexcelled street railway service, eight electric railways radiate from the city in eight different directions, bringing it into intimate touch with the territory within

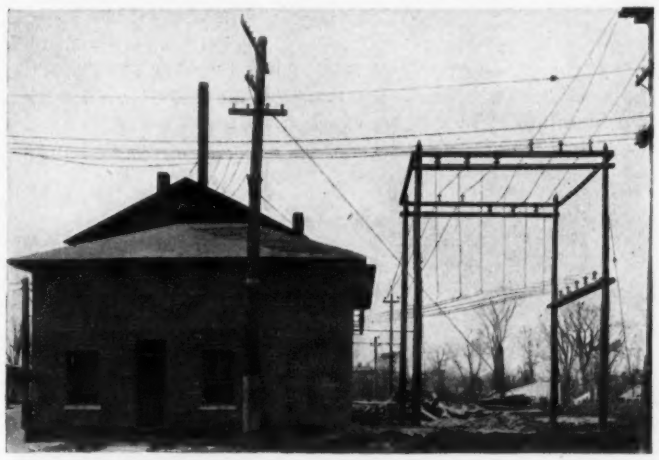


FIG. 6.—PROSPECT SUB-STATION, COLUMBUS, DELAWARE & MARION.

a distance of 75 miles, thereby rendering Columbus one of the principal interurban centers in the Central West.

Columbus is connected by through electric railway routes with Cincinnati and Indianapolis, and with only short links remaining to be built with Cleveland, Toledo, Detroit and Buffalo. The development of the interurban lines centering in Ohio's capital city has been so great that it is hard to realize the growth has taken place virtually within a period of four years. These lines give hourly passenger service, and are well built, well equipped

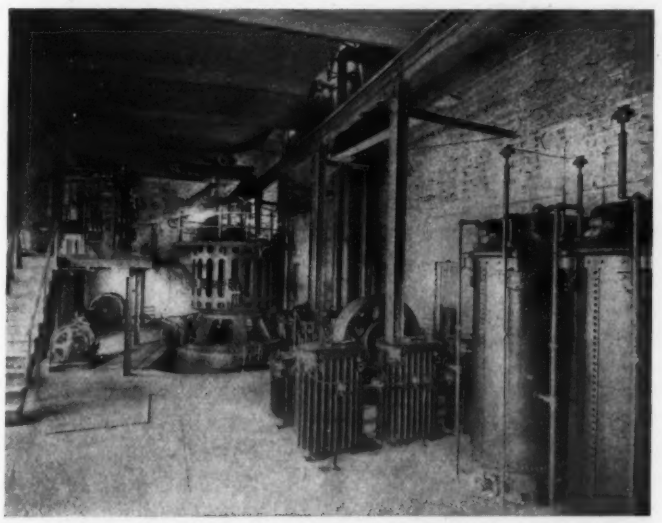


FIG. 7.—VERTICAL TURBINE IN STRATFORD STATION OF COLUMBUS, DELAWARE & MARION.

and well managed. In a multiplicity of ways this frequent and close connection between the country and the city has had an enormously stimulating influence upon the development not only of the capital city itself, but also of the country districts and towns as well. The early morning cars bring in many people employed in the commerce of the city, and the cars later in the day bring in retail and wholesale purchasers from all the surrounding country, while thousands of the city people use the interurban car in summer and in winter for pleasure and recreation, and as an important agency in their social life. Most of the lines maintain a freight and express service, bringing to the city the farm produce and products, and in exchange carrying to the farms and the country towns the manufactured articles and supplies furnished by the larger city.

The following are the interurban roads immediately centering in Columbus: Columbus, Delaware & Marion Railway Company; Scioto Valley Traction Company; Columbus, London & Springfield Railway Company; Columbus, Newark & Zanesville Electric Railway Company (controls the Columbus, Buckeye Lake & Newark Traction Company); Columbus, Grove

FIG. 8.—DOUBLE-TRACK CURVE, COLUMBUS, LONDON & SPRINGFIELD.

City & Southwestern Railway Company (operated by the Columbus, London & Springfield Railway Company); Columbus, Urbana & Western Railway Company; Columbus, New Albany & Johnstown Traction Company; Westerville and Arlington lines of the Columbus Railway & Light Company.

On each of the above-named roads four-motor equipments are employed exclusively. The 75-hp motor may be said to be the standard, although the Scioto Valley uses 100-hp motors. There is a decided tendency towards the adoption of multiple-unit

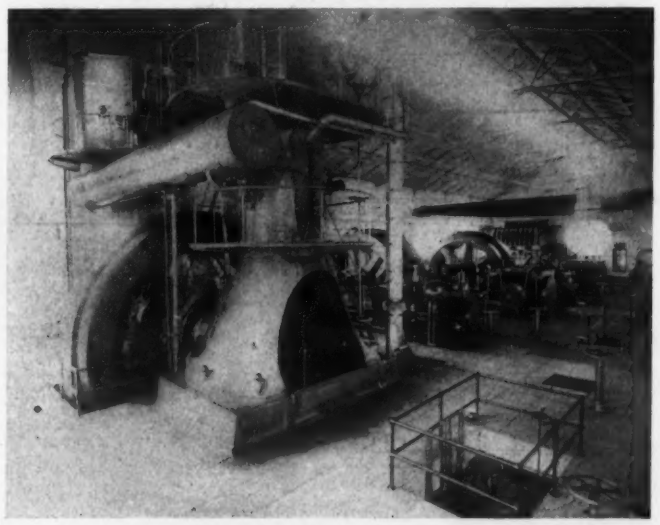


FIG. 9.—VERTICAL AND HORIZONTAL ENGINES IN HEBRON STATION OF COLUMBUS, NEWARK & ZANESVILLE.

controllers. In adopting these controllers probably the future operation of cars in trains has been considered, but evidently the avoidance of controller troubles has been the main consideration. The direct controller is generally conceded as being ill suited for controlling the larger types of motors. Flashing in the controller when the circuit is broken necessitates constant attention to the controller to keep it in operating condition. The

Scioto Valley, however, is using train operation in regular service on occasions of especially heavy traffic.

One of the large single generating stations connected with the above-named roads is that of the Scioto Valley Traction Company at Reese Station, where two 1,000-kw Bullock alternators, driven by Hamilton-Corliss engines, generate current at 375 volts, which electromotive force is raised to 27,000 for transmission to rotary converter sub-stations, which serve to feed direct current to the trolley line at 700 volts. The Columbus, Delaware & Marion Railway Company has a 2,000-kw Curtis turbo-generator now in service and is installing a second one.

The Scioto Valley system employs seven sub-stations between which the average distance is 10 miles, the longest transmission distance of the system being 41 miles. In these sub-stations there are used 18 150-kw Wagner oil-cooled transformers and six 150-kw General Electric oil-cooled transformers. The rotary converters are uniformly of 450 kw capacity, six being of the Bullock type and two of the General Electric type. The longest transmission by direct current in the Scioto Valley system is 12 miles.

Copper transmission lines are used by the great majority of roads, although considerable aluminum has been used during the past two or three years. The Scioto Valley Traction Company uses seven-strand aluminum of No. 2 capacity for its lines, and has obtained excellent results. One of the chief advantages found in aluminum is that sleet does not stick to it, in spite of the larger area of surface, and aluminum lines have gone through the most severe sleet storms without interruption while copper lines under similar conditions have broken down in many places. On the Scioto Valley transmission line 40-ft. poles are spaced 100 ft. apart, the cables being arranged in a triangle with 30-in. sides. The cables rest on 8-in. porcelain insulators, which are fastened on wooden pins. The circuits are transposed every two miles.

A recent study of the various transmission systems throughout Ohio has shown that the consolidation of interests and the grouping of systems which have been going on during the past two or three years have led to the abandonment of many of the smaller stations and the increasing of capacities of the larger ones, enabling electricity to be furnished over a number of connecting links from a single station. A few years back, when most of the interurban roads were promoted and built by separate groups of promoters, the practice was to build a separate power station for each road. Individual engineers followed their own ideas as to designs of stations and methods of generating and transmitting electricity, and the result of these numerous individual and disconnected efforts was that up to a year or two ago there were in Ohio a large number of comparatively small power stations, each supplying in its own way a single property regardless of conditions nearby.

Direct-current generation and transmission were used on the majority of the earlier lines, and as late as four or five years ago direct current was advocated and used on new roads of less than 30 to 35 miles. As a matter of fact, the direct-current scheme of transmission still has many advocates among the operators of the shorter lines, who, while they are paying somewhat more per kw-hour for electrical energy generated and have heavy investments in copper, which must some day be replaced, yet enjoy a comfortable feeling of security in times of high winds and severe storms, and they are inclined to view with sympathetic amusement the high-tension and sub-station troubles of their larger neighbors.

Fig. 10.—Interior Power Station, Scioto Valley Traction Company's Station at Reese.

Several of the earlier roads in Ohio using alternating-current transmission employed a potential of 10,000 to 13,000 volts, but later years have seen a growing tendency towards larger stations, larger units and higher voltages. Six years ago witnessed the building of the Toledo, Fremont & Norwalk Railway, now a part of the Lake Shore Electric Railways with a 2,000-kw station, 65 miles of road and 16,500 volts transmission. This was the most ambitious interurban project attempted in the district up to that time, and the layout represented the highest developments in the art. A little later came the Stark Electric and the Cleveland & Southwestern, with 22,000 volts and 24,000 volts transmission, respectively. Then came the Western Ohio with

an 80-mile line, 3,300-kw station and 33,000-volt transmission lines. This high potential was looked upon with some skepticism at the time, but it has since been adopted by the Toledo Urban & Interurban, the Fort Wayne, Van Wert & Lima, Cincinnati Northern, Columbus, Delaware & Marion and the Cincinnati & Columbus.

The economy of the large plants and the advantages of centralization of power have become generally recognized and there are several small roads in the district that are buying their energy at a flat rate instead of producing it themselves. Thus, the Lake Shore Electric supplies the Sandusky, Norwalk & Mansfield; the Western Ohio supplies the Fort Wayne, Van Wert & Lima, and the Springfield, Troy & Piqua supplies the Springfield & Xenia and Springfield & South Charleston.

FIG. 11.—LINE ANCHORAGE AT POWER STATION, SCIOTO VALLEY.

The St. Mary's power station of the Western Ohio takes care of 177 miles of road. The Cleveland & Southwestern, with 135 miles of road, has a single station, and it is the intention to add 86 miles to its load. The Medway power station of the Indiana, Columbus & Eastern supplies about 165 miles, and a considerable mileage will be added to this. The Schoepf syndicate, in completing its system from Cincinnati to Toledo, plans to supply with three and possibly two stations, while its line from Indianapolis through Dayton and Columbus to Zanesville will eventually be taken care of by either two or three stations. In view of the centralization and consolidation plans now under way, it is quité possible that five years will see 3,000 miles of interurban roads in Ohio operated from ten and possibly fewer power stations where at present there are fifty interurban stations in the State.

Of seventeen large interurban roads in Ohio, three still use the direct-current system transmission. These three are among the smaller systems, and are independently owned and operated. One large road buys its energy while the others employ transmission voltages ranging from 10,000 to 33,000 volts. Eight generate at low alternating voltage and step up to the desired transmission voltage. Five generate at the high voltage and transmit without the use of step-up transformers. A potential of 13,500 volts has been considered the maximum voltage at which electricity should be generated, but the Lake Shore Electric has one large unit generating at 16,500 volts. The roads using the higher voltages generate at a low voltage, usually about 400, and then step up. The longest transmission at this voltage is that of the Western Ohio, which transmits 95 miles from the station. The Lake Shore Electric supplies about 225 miles of road from its two stations. This line has a single stretch of 120 miles, and its stations, which are approximately the same size, are located at suitable distances from the ends of the line to distribute the loads between the two stations to best advantage. This company believes that two generating stations are better than one for a road of this length. The transmission lines are all tied in together and one station can assist the other in cases of emergency, even to the extent of handling the entire load

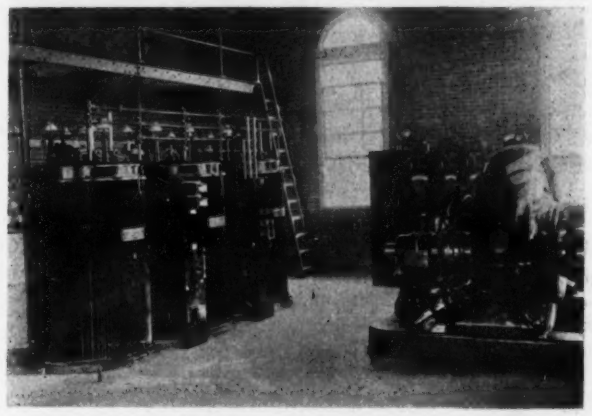


FIG. 13.—TYPICAL SUB-STATION, SCIOTO VALLEY.

if necessary. Of course, under normal conditions each station takes care of its half of the load, and the longest transmission is not more than 35 miles on the main line. The Western Ohio has its St. Mary's station practically in the center of its system, with lines radiating in four directions. The Cleveland & Southwestern station at Elyria is also well centered, transmission lines extending in three directions.

Sizes of units have increased with the growth of stations. In the earlier stations the 500-hp engine was looked upon as the most economical size. Later, in providing for additional equipments, many of the roads installed 1,000-hp units instead of two 500-hp, while in the new power houses on roads of 60 to 75 miles, two 1,000-hp units have been selected. New and additional equipments of more recent date have consisted of 1,250-hp engines in the cases of the Cincinnati & Columbus and the Toledo, Port Clinton & Lakeside, 1,500 hp for the Scioto Valley and 1,600-hp engines in the cases of the Lake Shore Electric and the Columbus, Buckeye Lake & Newark.

Steam turbines have been installed to some extent, and what are said to have been the first turbines used on electric roads were installed in Ohio. The first large installation of Westinghouse-Parsons turbines was that of the Cleveland & Southwestern, which has had two 1,250-kw units in use for more than three years. One of these turbines commenced operation De-

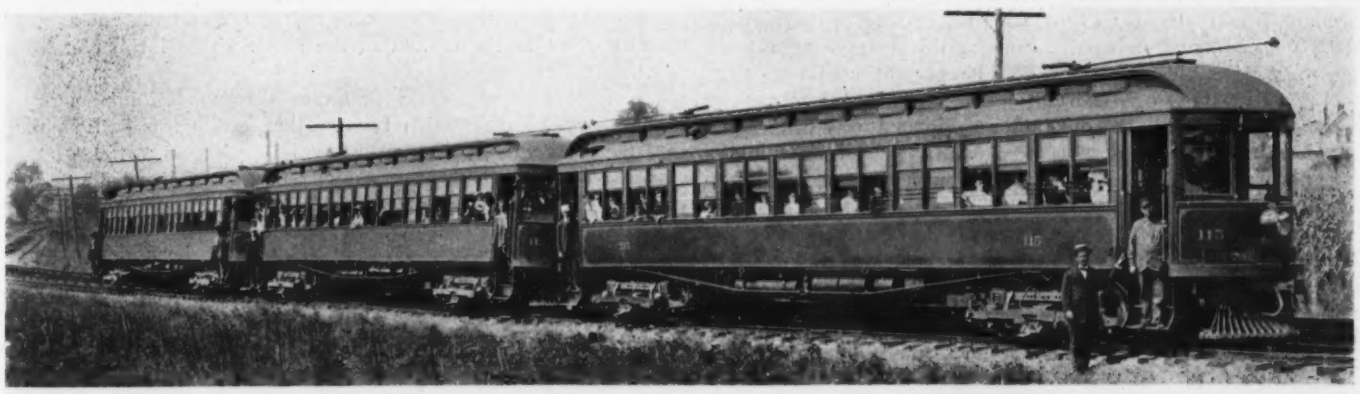


FIG. 12.—THREE-CAR TRAIN USED FOR HANDLING HEAVY TRAFFIC, SCIOTO VALLEY.

cember 20, 1903, and the other was started August 4, 1904. The station also has two large direct-current reciprocating units, which take steam from the same steam lines and supply to common bus-bars. Under average conditions the station generates electrical energy at about five and one-half mills per kw-hour. The two 1,250-kw turbines occupy one end of the engine room in the station while the other end is occupied by the two 500-kw reciprocating engines, and there is space in the turbine end for a third unit. The Canton-Akron Railway Company has a 2,000-kw Curtis turbine. The Northern Ohio Traction & Light Company has a 500-volt direct-current Curtis turbo-generator and is installing a large turbo-alternator. The Ohio Central Traction Company has a 150-kw DeLaval turbo-generator which has been in service for three years. The Lake Shore Electric Railway is installing a 2,000-kw Parsons turbine and is preparing to install an additional one.

It is interesting to note that the average rated capacity of the generating stations of the 17 interurban roads in Ohio is 24.1 kw per mile of track and 156.2 kw per car operated on an average schedule. Data on energy consumption also show interesting results. Thus by dividing the total station output for the year by the total car mileage it is found that the average for ten roads was exactly 3 kw-hours per car mile. The Western Ohio while operating at very high speed showed an energy consumption of 2.97 kw-hours per car-mile, showing the results of smaller motors than the average, and the advantage of liberal installations of feeders, bonding, sub-stations and general power conditions. The Scioto Valley, with ample power, plenty of feeders and good bonding, shows only 3.1 kw-hours per car-mile in spite of the use of 40-ton cars and 400 hp in motors to the car. Low grades and few stops also improve conditions for this road. The Dayton, Covington & Piqua, which had a low mark of 2.1, uses 35-hp motors, very light cars and its feeders and return circuits are ample.

Single-Phase Railway Equipment in Maryland.

The announcement that the Washington, Baltimore & Annapolis Railway has finally adopted the single-phase system and has placed contracts for the entire electrical equipment required for this line will attract considerable interest in engineering and railway circles, not only on account of the fact that this is one of the most important orders placed for alternating-current equipment in this country, but also because the original promoters of this line were the first to adopt the single-phase system. Some three years ago contracts were let for the construction of this line, but due to financial difficulties it was never built.

It will be interesting to compare the electrical equipment proposed at that time with the present equipment which has been ordered from the General Electric Company and which represents the latest practice in single-phase railway equipment. In the former plans for single-phase equipment between Baltimore and Washington it was proposed to use a trolley potential of 1,000 volts, current being delivered at this voltage at a frequency of 16⅔ cycles per second. The present contract calls for a trolley potential of 6,600 volts at a frequency of 25 cycles per second. On the cars a four-motor equipment was proposed, each motor having a capacity of 100 hp. The new car will be equipped with four motors arranged for either direct or alternating current, each motor having a capacity of 125 hp. While the first proposed motor equipments would have driven the cars at about 40 miles per hour, the new equipments, totaling 500 hp, will enable express trains on the road to attain a speed on tangent level track of 60 miles per hour.

The details of the new road have been carefully worked out by the Roberts & Abbot Engineering Company, of Cleveland, Ohio. Single-phase equipment was chosen only after the most careful engineering study had made it apparent that this system would prove most economical and best adapted to meet the special service conditions existing on this road.

Some 60 miles of road will be operated by the new company. The main line will be constructed between Baltimore and Washington, with a branch line, from a point on the main line near Odenton, extending to Annapolis. This station on the new line will be known as Academy Junction. Over the main line between Baltimore and Washington an express and local service will be established, express cars being operated under a fifteen-minute headway and making the run in 72 minutes. The roadbed will be double-tracked throughout, with sidings arranged at suitable intervals so that the locals may be sidetracked to enable the expresses to maintain schedules. The rolling stock equipment is to be very complete. Nineteen express cars, capable of making 60 miles per hour on a tangent level track, will be operated. In addition two work cars will be equipped, each sufficiently powerful to haul a train of five ordinary passenger coaches at 45 miles per hour, while four lower powered cars will be used for local service. These last-mentioned cars will run at a speed of 45 miles per hour. The express and work cars will each be equipped with four GEA-603 alternating-current-direct-current motor equipments with the Sprague-General Electric type M train control. The local cars will be similarly controlled, but will be driven by two instead of four motors.

Electrical energy for the new road will be purchased from the Potomac Electric Company at Washington, D. C., and will be delivered by that company at 6,600 volts, three-phase to a transformer sub-station located about three miles from Chesapeake Junction. In order to obtain a balanced load on the three-phase generators, the current as received at the sub-station will be changed from three-phase to two-phase by groups of two transformers connected three-phase on the 6,600-volt primary side and two-phase on the secondary side. Half of the transformers will have the secondaries wound for 6,600 volts and the other half for 33,000 volts. The 6,600-volt windings will all be connected in parallel on the same phase supplying single-phase current to the trolley as far as Academy Junction. The 33,000-volt secondary windings will all be connected in multiple on the second phase to the 33,000 volt transmission line, which will supply current to a step-down sub-station located at Academy Junction. The Chesapeake Junction sub-station will contain seven 800-kw water-cooled transformers, three with 33,000-volt secondaries and four with 6,600-volt secondaries, one of the latter transformers forming a reserve.

The sub-station at Academy Junction will be located adjacent to the car barns. For greater safety in inspecting and handling the cars all of the trolley circuits in the car barn will be arranged for 600-volt direct current, and for this purpose two 300-kw motor-generator sets will be installed in the transformer sub-station, changing the 6,600-volt alternating current to 600 volts direct current. The motor end of these motor-generator sets will be connected direct to the trolley circuits, one phase being led from the trolley coming from Chesapeake Junction and the other from the Academy Junction transformers. A feeder regulator will be placed in one phase so that the motor-generator sets will act as balancers, permitting the Academy Junction transformers connected on phase B to feed into the trolley line supplied by the Chesapeake Junction transpormers on phase "A." In addition to acting as balancers and to supplying current to the cars in the barns, the motor-generator sets will also supply direct current to the motors in the repair shops located at this point.

Government regulations within the District of Columbia prohibit the use of the track return so that within this section, the cars will be operated with a double trolley. This portion of the tracks, as well as that within the city of Baltimore, is at present operated by direct current, and the new cars are designed to operate on direct current over these sections of the line.

The present Washington, Baltimore & Annapolis Railway Company, which is constructing the line, is quite distinct from the initial corporation. The new company, under the head of its president, Mr. Geo. C. Bishop, has considerably broadened the former plans, land has been purchased for a wider right-of-way along the route, and new bridges are being built so that the roadbed will be excellent. The engineering work is in charge of the Roberts & Abbot Engineering Company, of Cleveland, Ohio, and contracts have been placed with the General Electric Company for the complete electrical equipment. The construction and operation of this road will be watched with great interest, as it is one of the largest and most important installations of the single-phase railway system ever undertaken.

Note on the Tractive Effort of the Single-Phase Commutator Motor Equipment.

BY B. G. BERGMAN.

ONE of the objections—by many considered as serious—to the use of the single-phase commutator motor for traction, and especially for heavy traction with locomotives, is the effect of the pulsating torque, which is characteristic of these motors.

The torque is proportional to the product of field strength and armature current. Consequently, if a sine wave variation be assumed of the same frequency and phase for each of these factors, the torque will vary as the square of a sine wave. In other words, the torque, being always unidirected, will pulsate between a zero and a miximum value. Such a pulsating torque is equivalent to a uniform torque—as exerted by direct-current motors—equal to the average of the instantaneous values during a full pulsation. It would seem, therefore, that the result would be that the same locomotive could start a heavier train, when equipped with direct-current motors than it could with an alternating-current motor equipment. For a given service this would mean an increased "dead" weight with resulting greater losses, if using the alternating system. Hence, the gain in other respects by its use would be more or less counteracted.

It is well known that the friction between a body and its support is greatest when the body is at rest; as soon as it is forced to slip, the friction decreases. From several tests it has been shown that this decrease takes place at a smaller rate with increasing speed of slipping. Hence, the maximum tractive effort or the maximum force between wheel and rail is obtained at the moment before the wheel starts to slip. This tractive effort is the limit for the useful pull with a uniform torque equipment. With an alternating equipment, on the other hand, supposing the pulsations transmitted to the rim of the wheel, the maximum "useful" or average pull will evidently be lower, as necessarily the slipping point will be reached first by those values of the pulsations which are above this average.

Looking at the matter from a purely theoretical standpoint and not considering the possible disturbing elements, it is evident that, when during the pulsation the slipping point at first is reached, the wheel begins to slip and will be accelerated until the acting force decreases and equals the frictional resistance. Then the wheel will be retarded and when the energy stored during the time of acceleration has been fully dispersed, the wheel, of course, stops. Thus there will be a periodical slipping of the wheel, before the continuous slipping—as resulting from a uniform torque—takes place. This evidently occurs when the periodical slips are no longer interrupted by any stops. Then the maximum useful tractive effort of the alternating equipment is reached.

Considering that the time for acceleration during the periodical slip becomes shorter with increasing frequency, it is clear that also the speed of slipping will decrease. Now referring to the variation of the coefficient of friction with the velocity, it seems probable that the maximum useful tractive effort will increase with the frequency and become equal to the static adhesion at infinitely high periodicity. If the dynamic friction were equal to the static friction, the maximum useful or average tractive effort would evidently be the same for a pulsating as for a uniform torque in spite of the periodical slips.

In this connection may be mentioned the influence of the "tilting" when produced by a pulsating torque. As is well known the "tilting" acts in a way to lighten the front end of the vehicle. This is of course especially noticeable at the start, when it shows itself by the front wheels being slipped before the rear ones. If the acting torque is pulsating, the "tilting" is greatest when the force driving the wheels has its maximum. Hence, the front wheels should slip earlier and the hind wheels later, if the "tilting" is pulsating than if it is uniform, but of an equivalent value. Due, however, to the general great mass of the vehicle and the considerable amount of spring used for suspension, the "tilting" pulsations will be practically eliminated and the maximum useful pull will be influenced mainly by the fluctuations of the driving force itself.

Considering the matter solely from the above points of view, it is obvious that the maximum useful pull must be lower with an alternating than with a direct-current equipment. There is, however, actually a phenomenon taking place which certainly is the more important, as it tends to eliminate the very cause of the lower maximum useful alternating pull. This phenomenon is due to the elasticity in the different parts transmitting the pulsating forces and is clearly illustrated, for example, by an alternating-current ammeter of the dynamo-meter principle. Although the torque is pulsating, the moving coil with the needle is perfectly still. The spring counteracting the deviation of the needle is consequently exerting a constant torque.

The principle is clear. The moment of inertia of the body must be great, and the greater the better, as necessarily then the acceleration and consequently the motion will be less during the

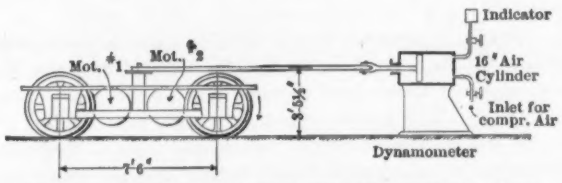


FIG. 1.—DIAGRAM OF APPARATUS FOR SLIPPING TEST.

different time intervals of the pulsation. Evidently an increase of the frequency will have the same effect. It is further obvious that the larger the deflection of the spring for a slight variation of the acting force or in other words the smaller variation of the torque of the spring for a given deflection corresponding to a certain motion of the body, the more the torque transmitted by the spring will approach a uniform value.

As this phenomenon can be mathematically expressed, there is a convenient way open to get an idea of the influence of the elasticity in the present case by making a calculation based on actual data; the results of an actual test are given below.

Fig. 1 shows the arrangements for the test and Fig. 2 indicates the result. A standard truck, equipped with two 100-hp single-phase motor, was placed on rough rails. As a dynamometer

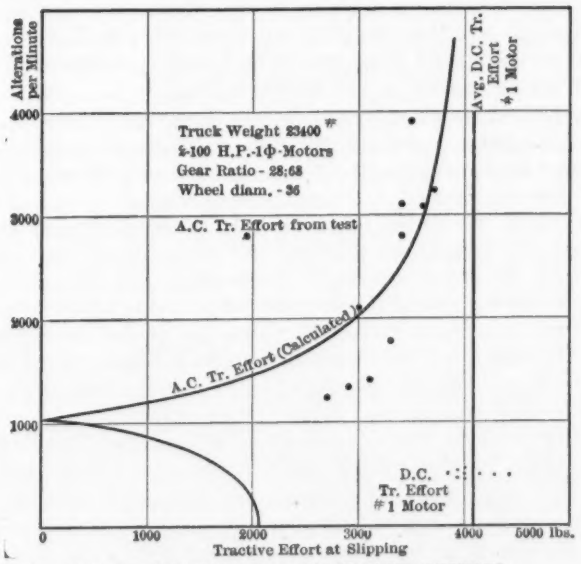


FIG. 2.—OBSERVED AND CALCULATED RESULTS.

there was used a 16-in. air cylinder, and the pressure was registered by an indicator. Through the motors was sent alternately direct and alternating current. The current was slowly increased until the wheels slipped, and it may be noted that the slipping point was very sharply marked by the instruments. One motor was used at a time and on the curve sheet are plotted points indicating the results for motor No. 1. The only difference in the results for the two motors was that due to the unequal weight on the wheels as produced by "tilting."

The test evidently shows an increase in useful tractive effort with increasing frequency in accordance with the above conclusions. As far as it is possible to judge from a test of this kind, with so many varying and uncertain elements entering in it, the tractive effort for slipping the wheels at the commercial frequency

of 25 cycles per second is about 15 per cent smaller for alternating current than for direct current, assuming, of course, that suspension gear arrangement, etc., are the same as for the truck used in this test.

The drawn curve shows the calculated value of the alternating-current tractive effort as found by considering the moment of inertia of the moving parts referred to the axis of motion, the torque of the spring device per unit of angular deflection, and the slipping point, which corresponds to a tractive effort of 4,100 lb., as obtained from the direct-current tests. This curve passes almost through the test points at about 3,000 alternations, thus giving the same tractive efforts as the test. The maximum angular deflection of the spring device is only .225°. It is interesting to note the point where the curve reaches the frequency axis. This point corresponds to the case when the "impressed" frequency equals the "natural," or in other words when resonance occurs.

The curve is, however, "pessimistic," as will be seen from the following: In its derivation the acceleration of the wheels, when slipping, was not taken into account due to the complications it would involve. The result would, however, be a higher tractive effort for alternating current. When the wheels begin to slip continuously the maximum value during the pulsation must be higher than is assumed; that is, than the value of the absolute static friction. As the tractive effort with alternating is less than with direct current, the "tilting" must also be less, consequently the weight upon the driven wheels must be greater, hence the slipping point higher than is assumed. Further the damping effect has not been taken into account. Taking these things into consideration, the curve is especially "pessimistic" at low frequencies as evidently with increasing frequency the above-mentioned effects have less influence.

It is further obvious that the maximum average tractive effort can never be lower than corresponds to the lowest value of the "dynamic" coefficient of friction. Hence actually the lowest part of the curve (above "resonance") would be bent down instead of as shown on the curve sheet. If the dynamic coefficient of friction were constant, that is, independent of the speed of slipping, the curve should have a sharp bend at the corresponding point, but due to the decrease of the "dynamic" friction with increase of speed of slipping—as discussed above—the curve would probably bend down gradually, giving a minimum of tractive effort at "resonance," as shown on Fig. 2.

Before making the final conclusions some words may be said about the influence of the oscillations of the motor itself, when it is geared to the wheel axle. The motor will tend to move in the same direction in which the reactive force from the gear acts upon the teeth of the pinion. Consequently, if an oscillation of the motor frame is possible, the armature must revolve correspondingly and the more the larger the amplitude of the oscillation. Considering the torque taken up by the moment of inertia of the armature, it is evident that the pulsations of the driving force upon the wheels can be eliminated by the oscillations of the motor frame and without elasticity between the armature and the wheel. A theoretical analysis also shows that the pulsations of the tractive effort can be entirely eliminated by suitably arranging the suspensions, but that exceedingly stiff springs are necessary.

As conclusion from these discussions, test results and theoretical application it can be said that a 25-cycle alternating-current equipment with geared motors, connected to the wheels in the standard way, seems to have about 15 per cent less maximum tractive effort than a direct-current equipment and that evidently considerably worse results would be obtained with gearless motors, the armatures of which were rigidly connected to the wheel axles; that with both geared and gearless motors, the alternating-current equipment can exert as high a tractive effort as a direct-current equipment by introducing sufficient elasticity somewhere between the armature of the motor and the rim of the wheel; that a rather slight flexibility is sufficient and that, therefore, perfectly practicable and reliable devices can be designed for such a purpose.

Finally it may be said that the greater cost for such a device and for its maintenance will probably be many times outweighed by the savings obtained by its use, as resulting from increased tractive effort and from less troubles to motors, pinions, etc., the cushioning effort of the device practically eliminating sudden shocks.

Standardization of Direct-Current Traction Motors.

At the Congrès International de Tramways et de Chemins de Fer d'Interet Local, held at Milan, September 17-21, a report was presented on the standardization of direct-current traction motors by a committee consisting of Prof. G. Kapp, of the Birmingham University, ex-Secretary of the Verband Deutscher Elektrotechniker; Prof. G. Rasch, of l'Ecole Polytechnique d'Aix-la-Chapelle; Prof. A. Blondel, of l'Ecole des Ponts et Chaussies, Paris; M. E. d'Hoop, technical director of the "Les Tramways Bruxellois" Company; C. H. Macloskie, chief engineer of the Allgemeine Elektricitäts Gesellschaft; James Swinburne, ex-president of the British Institution of Electrical Engineers, and Prof. W. Wyssling, of the Polytechnicum Zürich, and secretary of the Swiss Society of Electrical Engineers. Following is a translation of the report:

General.

1.—The following rules should be observed when machines are offered for sale, and when the sale is effected except where the seller and buyer, by mutual agreement wish to modify them:

Definitions.

2.—Rating.—The mechanical power developed by a motor or simply the power of the motor, is that power which is developed at the motor axle, in accordance with conditions as given below.[1]

The *continuous rating* of a motor is that power which can be developed for ten consecutive hours without undue heating as prescribed in paragraph 6 on Heating; the current being supplied at normal voltage.

The *normal rating* of a motor is that power which would be developed for one hour without interruption, and without undue heating, as prescribed in paragraph 6, on Heating; the current being supplied at normal voltage.

The *maximum rating* of a motor is that power which can be developed for five consecutive minutes with practically no sparking at the brushes; the current being supplied at normal voltage.

3.—Tractive Effort.—The tractive effort of a motor is the tangential force developed at the periphery of a wheel of specified diameter[2] for a given gear ratio. The conditions under which this force is developed are set forth in paragraphs on Acceptance.

4.—Speed.—The speed of a motor is the peripheral speed of the car wheels produced when the chosen gear ratio is employed.

5.—Efficiency.—The efficiency of a motor is the ratio between the mechanical power developed by the motor to the electrical power supplied to the motor terminals, the current being supplied at normal voltage.

6.—Heating.—A motor is said to be overheated, when, starting at an atmospheric temperature of 25° C, it runs continuously for ten hours at its continuous rating, or for one hour at its normal rating, and at the end of the specified period the temperature of the motor has exceeded that of the surrounding air by the following amounts:

(a) Windings.

Cotton insulated	70° C.
Paper insulated	80° C.
Mica insulated, or other substances having the same insulating and heat resisting qualities	100° C.
(b) Commutator	80° C.

(c) The cores in which the windings are imbedded should have temperatures corresponding to those given for the windings, according to the nature of the insulation. When the windings are insulated with combinations of the above given materials, the lowest temperature limit is taken.

[1] In certain special cases, it may be desirable to know the power of the motor itself exclusive of the gearing, axles, etc. In this case the word "propre" is added to each of the above described methods of rating.

[2] In the case of direct-connected motors the tractive effort will be that developed at the end of an arm 50 cm. long supposed to be mounted on the motor axle.

Specifications.

7.—The specifications should contain, in addition to the normal voltage, the following data, all referred to the normal voltage:

(1) The continuous rating of the motor and the corresponding value of the current.

(2) The normal rating of the motor and the corresponding value of the current.

(3) The maximum rating of the motor and the corresponding value of the current.

(4) The efficiency when running respectively at the continuous rating and at the normal rating, the temperature of the motor being taken as 75° C.

(5) The character of the insulating materials.

(6) The over-all dimensions of the motor. The gear ratio for a given diameter of wheel, tractive effort and speed, both at the continuous and normal ratings must be given. Performance curves showing the tractive effort, the speed and the efficiency of the motor plotted with current value must also be given.[3]

Name Plate.

8.—In addition to the above data, contained in the specifications, each motor shall bear a plate giving the normal voltage, the normal rating, the speed and the corresponding current value.

Construction.

9.—The frame should be so constructed as to avoid magnetic leakage; it must be dust proof and also proof against water which might be thrown against it when in service. The frame must be fitted with openings which permit the maintenance of the brushes; said openings being hermetically closed. By maintenance of the brushes is not meant merely the renewal of the brushes but also the renewal of the brush holders.

10.—The bearings should be so constructed as to prevent the introduction of oil or grease into the interior of the motor.

11.—The motor, and notably, the commutator and the brushes, should be so constructed that the motor will run equally well in either direction without changing the position of the brushes. The sparking should be practically nil for all loads below the maximum rating.

12.—The insulation of the windings from the cores and frame should be such that, immediately after the motor has attained its maximum allowable temperature, it will be able to resist for five minutes an alternating voltage, the value of which is four times that of the normal voltage.

13.—All parts of the motor which will be liable to be replaced, in particular the armatures, field coils, the armature coils, the commutators, etc., should be interchangeable, i. e., these parts should be replaced without incurring the least work outside of mere adjustment; the removal of the armature should take place without disturbing the brush holders.

Acceptance Tests.

14.—The acceptance tests shall be made before the motors are mounted on the cars; these tests consist not only in an examination into the general conditions of good manufacture and good construction but especially in the determination of the power, the tractive effort, the speed, the efficiency and the heating.

(A) Determination of the Mechanical Power.

15.—The mechanical power of a motor can be determined with an absorption dynamometer, which may be in the form of an electric generator coupled directly to the motor axle. The efficiency of the generator must be known for each condition of load. The generator cannot be replaced by a traction motor similar to the one under test and driven by gearing.

(B) Measurement of Temperature Rise in the Power Tests of Motors.

16.—The rating of a motor is determined, according to definition, by the temperature rise.

17.—It is not permissible to take away, open or modify the case, covers, etc., which should be left as they will be in actual operation. It is also not permissible to produce artificially the current of air which would be caused by the movement of the car.

18.—The temperature of the surrounding air should be measured in each existing current of air; if any predominant current did not make itself felt, the mean temperature of the air surrounding the motor should be measured at the height of the middle of that current, and in both cases at a distance of about one meter from the motor. The temperature of the surrounding air shall be taken at regular intervals during the last fifteen minutes of the test, and the mean of the readings shall be taken.

19.—In case a thermometer is used to measure the temperature, an attempt must be made to get the best possible conduction of heat between the thermometer and the part of the motor, the temperature of which is to be measured, for example by means of a tinfoil coating. To avoid the radiation of heat, the thermometer wells and the parts of which the temperature is to be measured should be covered with substances which are poor conductors of heat (waste, or similar material). A thermometer shall not be read until the mercury has ceased to rise.

20.—The temperature rise of all parts of the motor, except the field coils shall be measured with thermometers. Where possible the temperature should be measured at those points where it is greatest.

21.—The temperature of the field coils should be determined by the resistance method. If the temperature coefficient of resistivity of copper has not been determined it can be taken as 0.004.

(C) Determination of the Efficiency of Motors.

22.—In determining the efficiency of a motor alone, or with its gears, the absorption dynamometer method can be employed; fastening the brake on the motor axle in the first case, and upon an auxiliary axle which will take the place of the car axle in the second case. It is also possible, by exercising proper care, to use purely electrical methods as outlined in the following paragraphs:

23.—The combined efficiency of the motors and their gearing is determined by one of the two following methods:[4]

(A) Two motors to be tested are coupled together mechanically by an auxiliary axle carrying a gear similar to the one on the car axle and engaging with the pinions of the motors.

One of the motors should have the normal voltage, E, impressed across its terminals and running as a motor will consume a power equal to EI corresponding to the normal rating of the motor; the other motor will act as a generator and will deliver a power equal to EI'. The power supplied and the power delivered being measured the efficiency of one motor and its transmission will be

$$\eta = \sqrt{\frac{EI'}{EI}}$$

As a check it is advisable to measure the power Ei absorbed by the system:

$$Ei = EI - EI' = I - I'$$

(B) Two motors to be tested are coupled together mechanically by an auxiliary axle carrying a gear similar to the one on the car axle and engaging with the pinions of the motors. One of the motors should run as a motor and the other as a generator; they should be interconnected electrically so that the only power, P, taken from the external source will be that required to supply the losses. If the total power furnished to one motor is P_1 and the total power delivered by the other as generator is P_2, then $P = P_1 - P_2$ and the efficiency of one motor with its gearing is

$$\eta = \sqrt{\frac{P_2}{P_1}}$$

The quantities P_1 and P_2 should be measured directly and electrically. As a check it is advisable to measure the power, P, furnished the system to supply the losses.

24.—In case it is desired to find the efficiency of motors intended to be coupled directly to the car axle, the above methods can be applied by coupling the motors directly together.

[3] In certain cases it may be desirable to know the heating and cooling curves of the motor when working at its normal rating and subsequently at other outputs, also those of the field coils and the armature coils when the motor is closed and at rest.

[4] The methods described above are not theoretically exact, because of the differences in the methods of connecting the two parts of the system; the error, however, remains within the permissible limits as long as the gear ratio is small.

Lighting of Small Stores.

At the recent meeting of the Colorado Electric Light, Power & Railway Association, Mr. J. R. Cravath presented a paper with the above title, intended mainly to be of assistance to central station men in the smaller towns who are looking for pointers on how to light stores electrically so as to give good results, please customers, and meet the competition of kerosene, gasoline, acetylene and gas. Stated in its simplest terms, he said, the object of artificial lighting is to enable us to see things. No amount of ornamental effect with electric light can please the owner or the customers of a small store unless enough light is delivered on the counters to enable them to see clearly what passes over the counters. This useful illumination of the counters and lower part of the store is evidently, therefore, the first matter to be looked out for. But there is also something more. In the lighting of a store, in addition to the question of how much light can be obtained on the counters and shelves, there is also the general impression the lighting of the store makes upon the public. The lighting of stores is partially in the nature of advertising, as is recognized by all the most progressive merchants in both large and small towns. The whole problem of store lighting, therefore, is one of combining maximum useful illumination with the best advertising effect possible.

When incandescent electric lighting was first introduced in small stores, the usual plan, and one that is still in very common use in country and suburban villages, was to hang a row of bare incandescent lamps on drop cords over each counter the length of the store, thus making in the ordinary store, which is 20 to 25 ft. wide, two or three rows of incandescent lamps. These lamps were usually hung about 6 ft. above the floor just high enough to escape the heads of clerks and customers and incidentally just high enough for the light to shine directly in a customer's eye should he attempt to look the length of the store. The whole effect is crude and the apparent illumination is nowhere near what it might be with some very inexpensive modifications. The first objection to this arrangement is that a person looking the length of the store is partially blinded by the light which comes directly in his line of vision. As a result, the store appears darker than it really is both to those inside and to those looking into it from the street, because the bright light prevents the eye seeing things beyond the light. Besides this, the bare lamps look crude and sickly. Especially is this true where the store adjoins one lighted with gas or gasoline mantle burners, which are usually provided with diffusing glass chimneys or globes which give the appearance of light coming from a large surface. The incandescent lamp, under such circumstances, looks much like a red-hot hair pin. To simply enclose these bare electric drop lamps with globes of frosted or sand-blasted glass would improve the general effect decidedly, but there is room for considerably more improvement without making radical changes. In fact, such a store can at a small expense be made one of the most efficiently lighted stores in town for the reason that its outlets are so well distributed over the store.

After equipping the lamps with frosted bulbs the next step in improving the lighting should be to raise the lamps to a height of 8 or 10 ft. above the floor and equip them with opal or prismatic glass reflectors in order that sufficient light may be delivered on the counters while at the same time enough escapes to the shelves and ceilings. This will raise the lamps out of the line of vision so that they do not interfere with seeing across the store, while the reflectors will deliver enough more light downward to compensate for the raising of the lamps higher above the counters. As to the proper reflector to select for such an equipment, photometric curves are now obtainable for nearly all the best known types of glassware on the market. The author stated that the reflector should be one delivering most of its light at angles below 45 degrees from the horizontal, but at the same time allowing enough to go up and sidewise to provide well for the ceiling and shelves. The ceiling should be light in tint to produce the best effect at night. It is impossible to make a store look bright and cheerful if provided with a dark ceiling and dark finish throughout. If the store owner can afford something better than bare drop cords the one-lamp chain pendants now obtainable at very reasonable figures make good substitutes for drop cords. If preferred, a permanent solid one-lamp pendant can be used.

As far as the amount of useful light obtained for a given expenditure is concerned, this arrangement of rows of incandescent lamps about 8 or 10 ft. above the floor with proper reflectors is the most efficient store lighting scheme that can be devised. It is at the same time pleasing in appearance. No central station man, however, wants to recommend the same plan of lighting for all his store customers. The idea in the merchant's mind of having something a little better or a little different from his neighbor is a powerful stimulus to the growth of a commercial lighting load.

No plan of store lighting can compare in efficiency with incandescent lamps in proper reflectors well scattered over the area to be lighted. There has been recently a great increase in the use of clusters of incandescent lamps, these clusters being used as substitutes for various large lighting units, such as electric arc lamps, gas arc lamps and chandeliers. It must be evident that the principal things in favor of such clusters are their low first cost and pleasing appearance, the pleasing appearance being due to the fact that they are usually equipped with frosted bulb lamps. It must be evident that the lamps themselves are of no higher efficiency than if they were used as scattered individual units, while there is considerable loss in illuminating efficiency because of the great area which must be covered by one cluster. Mr. Cravath was not prepared to say that such incandescent clusters are not good to use in some places, but the results are likely to be disappointing if a merchant changes from distributed lighting to cluster lighting without increasing his current consumption. Rather than use clusters or chandeliers with a number of incandescent lamps, it is better to use a large, higher efficiency lighting unit of some kind, such as one of the new high candle-power incandescent lamps or the Nernst lamp. Even with these large high efficiency units there is too much of a tendency to use a few large units rather than a larger number of small units. Where ceilings are not too high and lamps can be scattered over the ceiling, the inverted bowl type of reflector is worth serious attention.

While considering the greater efficiency of small scattered units of illumination as compared to large units, one must not, however, forget the fact that there is a certain advertising value in a large lighting unit such as the arc lamp, Nernst lamp, or big incandescent lamp. A few large units in a store probably create more of an impression on the casual passer-by than rows of smaller units, unless the smaller units are provided in such profusion as to attract attention. In regard to the proper use of Nernst lamps in store lighting, the directions are very simple. They should be placed high and immediately over the areas to be lighted, since their distribution of light is mainly downward like that of an incandescent lamp with a fairly concentrating reflector. For this reason it is usually advisable to place a row of Nernst lamps over each counter, where with arc lamps, which give a wider distribution, a single row down the middle of the store would answer. Nevertheless, many stores are well lighted with single rows of Nernst lamps, the results being considerably better than with alternating-current arc lamps, especially if the alternating-current arc lamp happens to have an inefficient type of reflector. In purchasing arc lamps for store lighting it is well to secure those with small carbons even though they may require more frequent trimming, as the results in steadiness of light will be so much better and the efficiency will also be considerably higher than with large carbons. By small carbons is meant those five-sixteenths or three-eighths of an inch in diameter. Dirty globes can reduce efficiency a great many per cent and it is poor practice to allow arc lamp globes to go more hours without cleaning than a small carbon arc lamp will burn between trimmings.

Show window lighting, like the lighting of the store itself, must be a combination of useful lighting and display or decorative effect. In a few stores of the very highest class in our great cities, the character of the goods themselves is such that the goods alone are the best display that can be made. Window lighting in such stores is therefore planned entirely to conceal the lamps and simply to make the goods in the windows stand out clearly. Trough reflectors at the top of the window are

commonly used in this class of lighting, but in nine cases out of ten conical reflectors either of the mirror or prismatic types would give much better results for the money. Less light is wasted with conical reflectors placed over each individual lamp than with a row of lamps in trough reflectors.

In small stores the window display itself may frequently with advantage be supplemented by electric lamps as a decorative feature. In other words, the useful and decorative features of electric lamps can be combined in the same window. As a starter in the smallest stores, one can place a row of downwardly pointed lamps in conical prismatic reflectors across the top of the window. These will serve to make a display and attract attention to the window and at the same time will throw light down to illuminate any goods that may be in the lower part of the window. No one can see much in the top of the window in the vicinity of the lamps, but that does not matter in such a case. If there are no goods in the window to light and the object is simply to make a display of electric lamps, there, of course, is no limit to the designs that can be used.

It should be the aim of every central station man to gradually push up the accepted standard of illumination among the stores in his town. The tendency in this respect is upward anyway, but the central station man can hasten the process. The stores in some cities have very much lower standards of illumination than those in others of the same size. This is very noticeable to one visiting the various towns. The difference is partly due to the progressiveness and prosperity of the merchants, but very largely to the enterprise and methods of selling energy of the central station company. If your town appears to be a dead one in the commercial lighting business, select some of your more enterprising merchants who are inclined to do better than their neighbors (and there are some in every town) and work with them to get them to put in an installation by which their stores will be really well lighted. You can even afford to do some work subject to 30 days' trial and approval and get started this movement to raise the lighting standards among the stores of your town. After some merchants are started right, others will follow. Your stores ought to be taking from one to one and one-half watts per square foot of floor space. How many of them are? This may seem like a rather high standard to set for the stores in a country town, but it should at least be aimed at.

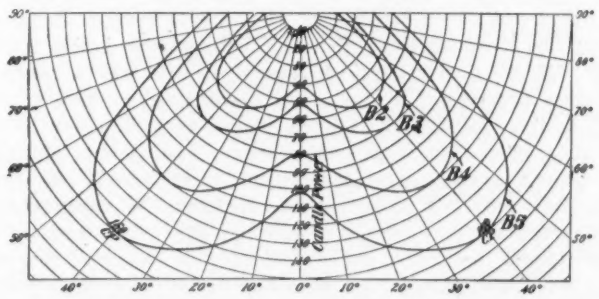
The Incandescent Lamp.

In a paper read recently before the Vermont Electrical Association, Mr. F. W. Willcox, in discussing the present status of the incandescent lamp, emphasized its importance by the statement that incandescent lighting forms over 52 per cent of central station income. Improvements in lamp efficiency are, therefore, of far-reaching importance, and the incandescent lamp, by reason of its great simplicity and many advantages over other lighting devices, will in the average case, have preference for illuminating work at equal or better efficiency. Improvements in efficiency will increase the proportion of incandescent lighting income, widen the field for electric lighting and add greatly to the volume of business. The present incandescent lamp is almost an ideal piece of apparatus. It has no separate parts; has no moving parts; requires no adjustment; gives equally satisfactory life on both alternating-current and direct-current circuits; is available for use in multiple on constant potential or for use in series at constant current; it is satisfactory at any frequency not below 25 cycles; has a 100 per cent power factor, can be obtained for any voltage from 3 to 300; it is divisible into small units, is producible in the smallest intensities, and is available in range and size from the smallest candle power to several hundred candle power. It will operate at any angle and almost under any condition from a vacuum to a caisson pressure, moist or dry, under water or in any liquid fumes or gas (with terminals protected) except glass corroding acids—can be used stationary, moving or under severe vibration at any temperature from far below zero to 800° F.—at which point glass begins to soften. It is adapted to use with shades and reflectors to secure any desired distribution of light, and avoids the brilliant light of the arc lamp. It is small and inconspicuous and suited for any surroundings, plain or artistic. The light is of the most agreeable color, and the lamp is silent, simple, safe, reliable and "fool-proof." The investment cost is also inexpensive.

Curves were shown of the light distribution from high lamps fitted with the new "bowl" reflector. This reflector secured more nearly ideal results in respect to uniform illumination than any other reflectors or commercial lighting device. Uniform distribution is given over an area equal in diameter to 1½ times the height of lamp; the distance between lamps for uniform illumination is 2½ times the height. Desirable practice aims not only to guarantee the lamps but also to guarantee the illumination, and the unit idea of lamp and reflector is a great aid to this end. Herein lies in part the reason for the omission of candle power from the new lamp labels, for which is substituted the watts, so that lamps can be ordered of an efficiency to give suitable life under different conditions. The omission of the candle power from the label does not mean that candle power ratings are to be abandoned, but it does mean that more accurate definitions will be used in referring to this item. The proper unit is the watt and not the candle-power when energy is sold by the watt hour.

A new standard 50-watt lamp giving 20 cp mean horizontal has been made to comply with the wishes of the leading central station companies, who asked the improvement in efficiency given in the form of 25 per cent increased candle power, with the total watts per lamp unchanged. This is perhaps a more apparent improvement than a 20 per cent reduction in watts per lamp would be. The movement appears to be away from a 16-cp standard. It is not enough in many cases, and in other cases it is too much.

Mr. Willcox described the tantalum lamp at some length and



ILLUMINATION OBTAINED WITH BOWL REFLECTOR.

presented a table comparing its qualities with the new high efficiency graphitized filament units. Thus far the only available tantalum lamp in this country is the 22-cp, 44-watt size. The useful life on direct current is about 700 hours, and only about 200 for lamps on alternating circuits. The lamp burns to best advantage in a pendant position. It is not nearly as sensitive as the carbon filament lamp to change of voltage. The tantalum lamp has a probable limit of 20 cp in very efficient sizes. It is somewhat more fragile than the carbon filament lamp and suffers from vibration somewhat. Present prices of tantalum lamps hardly permit free renewals. At the present prices put into effect September 1, the tantalum lamps cost about 200 for lamps on alternating circuits. The lamp burns thereon would make a difference of about 30 to 35 cents as a charge for the tantalum, without any increase for renewal costs over those for stations furnishing free renewals at present. This represents the price of a Welsbach mantle and this would enable the tantalum lamp to compete with the mantle on fairly even terms.

Mr. Willcox concluded with a strong plea for the practice of illuminating engineering in place of the haphazard lighting service still given in many quarters. The importance of efficient installations at the customers' ends is worth far more than the improvements at the station's end. Scientifically designed shades and fixtures are a vital necessity to effectual electric light competition. Great as are the gains of efficiency with the new filaments, still greater gains are possible with the more efficient use of lamps.

Electrolysis of Gas and Water Pipes.

At the convention of the Central States Water Works Association, held in Cincinnati on September 27, there was quite an animated discussion regarding electrolysis. Mr. J. J. Pater, formerly connected with the Hamilton (Ohio) water works, contended that the trouble from electrolysis was attributable to single trolley lines. He claimed that after six months the bonds used on the tracks became absolutely valueless. If the water mains were one continuous iron pipe there would be no trouble with electrolysis; but every twelve feet there is a broken joint, a lead joint, which the current has to jump over, and the resistance causes trouble in the water mains. He was satisfied that clean grey cast-iron pipe which should ordinarily last one hundred years in good soil would now only last eighteen or twenty years. He cited many instances where electrolysis due to street railway current was responsible for the destruction of gas and water pipes, and also where it had endangered the steel work of sky-scrapers and ended by stating that the only remedy was to keep the current off the ground and off the rails by using the double trolley system.

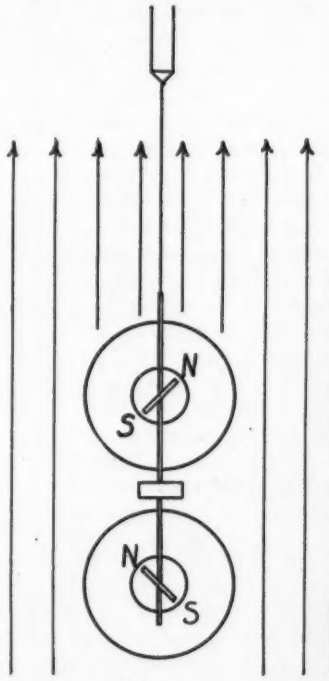
Mr. Hornung, formerly superintendent of the Newport (Ky.) water works, and now a consulting engineer in Cincinnati, where the double trolley system is in use, made some very interesting remarks in rebuttal. He said that he was the consulting engineer for the single trolley road in Cincinnati and remembered that in extending that road he had hitched to everything he could get hold of for the single trolley. The road was operated for a number of years with no evidence of electrolysis of water pipes even to this day. He did not maintain that electrolysis was impossible, but he took issue with anyone who claimed that it was due to a single trolley system entirely. Theoretically the double trolley system is a preventative of electrolysis; but it has not been found to be such in practice. From experiments conducted by him, Mr. Hornung knew that in Cincinnati the double trolley system did not protect against electrolysis. It was a common occurrence for people to run away from a fallen wire of the double trolley system and he knew of horses having been killed by coming in contact with such a wire. The system had very many leaks and it was almost impossible to insulate it. At every switch the system was complicated. He cited the experience of a motorman who was operating a trolley car on a street which also contained the double trolley system. It happened that the trolley wheel had jumped his wire and in the hurry to readjust it he got his trolley wheel over on the double trolley wire and the incandescent lamps in the car instantly glowed. To make sure that the motorman was telling the truth Mr. Hornung took out a car the same night and by throwing the trolley over onto the double trolley line the lamps glowed as the motorman said they did. The next night he took out a car to see whether he could not operate it with current from the double trolley system, which, it was claimed, had no leaks, and which was such a protection. After throwing the trolley pole over as before he took hold of the controller and while the car did not move there was a perceptible torque. A number of years after a party came from England to study the double trolley system as a protection against electrolysis. He related to him his experience and the Englishman being a thorough electrician, said that if he could show him something of that kind he would have no occasion to make any tests as to whether or not the double trolley was a protection against electrolysis. The experiment was repeated with practically the same result. Mr. Hornung gave this as evidence that the double trolley system is not a protection against electrolysis. If it were he said one could take hold of the fallen wire without danger, and Cincinnatians knew that this was not so. He knew from experience that electrolysis did exist, but could not make up his mind that it was due entirely to a single trolley road. There were many stray currents produced by other than railway plants, every one of which will produce electrolysis. When all the cars on the single trolley line were in the barn the ammeter readings would be zero, whereas with the double trolley system he was informed that the ammeters registered a considerable current.

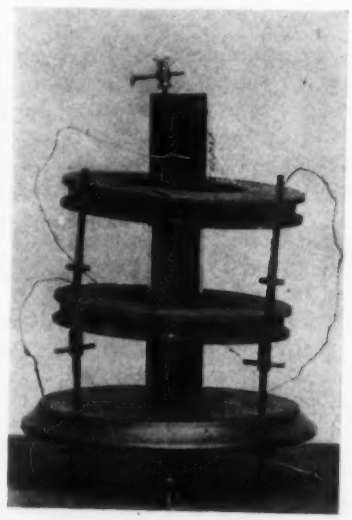
In reply to a question if all other wires were not kept from the ground, Mr. Hornung said that the wires were so kept, but not the current of electricity, which leaked to the ground in spite of all that they could do to prevent it. Mr. Pater said that in Franklin, Ohio, where there was only the single trolley line in the whole town, one could see the sparks fly from the fire plugs at night. Mr. Bosch said that he had charge of a plant at Washington, Ind., and he had no trouble with electrolysis except at two plugs where the street cars went up grade and required considerable energy. At this point he had to renew small service pipes once a year. The gas company's mains were eaten out twice in three years. At no other point was trouble experienced. He was of the opinion that arc light systems were just as detrimental as street railway systems, as both were grounded.

A New Type of Alternating-Current Galvanometer.

By W. S. Franklin and L. A. Freudenberger.

The galvanometer illustrated herewith is essentially a modified Kelvin astatic galvanometer adapted for the use of either direct or alternating currents. From the results of tests and actual use of the instrument within the last six months, the sensitiveness has been found to vary from ⅓ to 1/10 that of the ordinary Kelvin astatic instrument. As with the ordinary Kelvin instrument, high sensitiveness is obtained by the use of proper windings for the galvanometer coils. The sensitiveness of the





FIGS. 1 AND 2.—ALTERNATING-CURRENT GALVANOMETER.

alternating-current galvanometer will be appreciated when it is known that an instrument having a resistance of 950 ohms had a sensitiveness of 10^{-9} amperes per millimeter per meter.

From Fig. 1 it is seen that the galvanometer consists of two small soft iron magnets and a mirror fastened to a thin glass rod and suspended by a single silk or quartz fibre at the center of two galvanometer coils; through these coils the current to be measured is led. The magnets are inclined 45 deg. to the axis of suspension, as indicated. The magnet system, as a whole, is suspended in a uniform vertical field, as shown by the arrows in Fig. 1. This vertical field is produced by two Helmholtz coils entirely surrounding the galvanometer proper (Fig. 2). The current for producing the vertical field is obtained from the same source as the current to be measured.

A perfectly astatic needle system suspended in a perfectly vertical field would be in equilibrium and point indifferently in any direction. By slightly tilting the Helmholtz coils, a slight directive tendency may be given to the needle system. Fig. 1 would represent the conditions obtaining during one-half of an alternating-current cycle. During the next half cycle, both the vertical field and the current in the galvanometer coils reverse simultaneously and the deflection thus remains in the same direction.

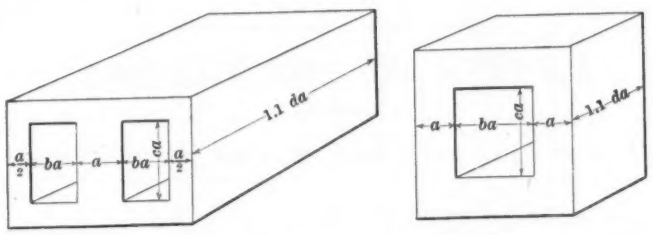
Transformer Design.

BY A. COGGESHALL.

IN many of the alternating-current text-books the development of transformer design is made to depend upon dimensional expressions. These expressions are derived for the several factors of the design, and are all expressed in terms of one linear dimension of the core. What may be called the fundamental transformer equation, $E = \sqrt{2}\,\pi\, N f\, \phi\, 10^{-8}$ and the current rating, must also be considered to introduce the limitations of capacity.

It is the purpose here to show by this treatment how the size and weight of a transformer vary with the capacity and the density, and how the density at which the minimum losses obtain is readily found and the performance of the transformer predetermined.

In Figs. 1 and 2 are shown views of shell-type and core-type transformer cores. Let a be the width of the path taken by the



FIGS. 1 AND 2.—VIEWS OF SHELL-TYPE AND CORE-TYPE TRANSFORMERS.

total core flux, and let the dimensions all be expressed in terms of a centimeters as indicated.

Then briefly summing up the expressions as partly given in the text*, and which are easily derived, we have the following:

Let E = secondary voltage,
f = frequency,
N = secondary turns,
β_m = maximum flux density,
I = secondary current,
k = ratio of winding area to section of copper,
m = cir. mils per ampere,
S = area of section of iron,
P = kilowatts at an assumed power factor of unity.

$2NIm\,k$ = area of winding space in cir. mils,

$2NIm\,k \times .7854 \times 10^{-6} \times 6.45 = bca^2$ area of winding space in sq. cm.

From which
$$I = \frac{bca^2\,10^6}{10.13\,kNm}.$$

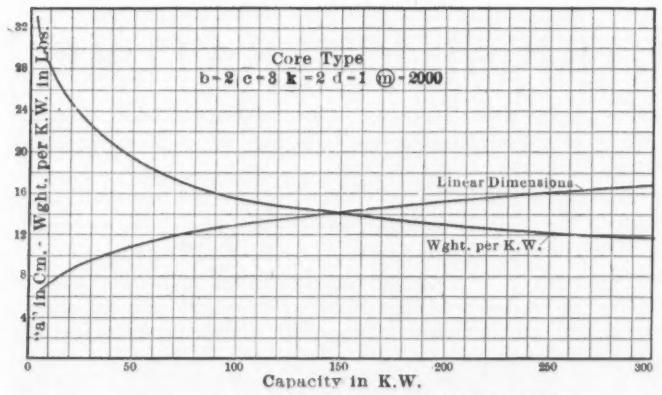


FIG. 3.—SIZE AND WEIGHT OF TRANSFORMERS.

Whence substituting for N from the fundamental equation and remembering that $EI\,10^{-3} = P$ and $\phi = \beta_m\, da^2$.

$$a^4 = \frac{228\,k\,m\,P\,10^3}{b\,c\,d\,f\,\beta_m}. \qquad (1)$$

* Mr. F. G. Baum has given this method probably the most extended treatment of any text in his book, entitled "Alternating Current Transformer."

The volume of iron is $V_i = 2\,d\,a^3\,(b + c + g)$, (2)
where $g = 1$ for shell type, $g = 2$ for core type; a cu. cm. of iron weighs .017 lb.

Hence it may be found that the weight of iron per kw equals

$$\frac{7.7\,k\,m\,10^3\,(b + c + g)}{a\,b\,c\,f\,\beta_m}. \qquad (3)$$

From the mean length of a copper turn $a(2 + 2.2\,d + h\,b)$, where $h = 2$ for core type and $h = 4$ for shell type, it may be shown in a similar way that the weight of copper per kw equals

$$\frac{4.47\,m\,(2 + 2.2\,d + h\,b)\,10^3}{a\,d\,f\,\beta_m}. \qquad (4)$$

Also the ratio of the resistance drop, IR, to the total voltage is equal to the ratio of the copper loss to the total watts =

$$\frac{2\,(2 + 2.2\,d + h\,b)\,10^3}{11.3\,m\,f\,\beta_m\,d\,a} \times 100. \qquad (5)$$

To find the per cent of iron core loss take the loss per lb. as equal to

$$\frac{1.6\,n\,\beta_m^{1.6}\,10^{-10} + 2.5\,f^2\,t^2\,\beta_m^2\,10^{-11}}{.017}.$$

Considering the hysteresis exponent as 2.0 instead of 1.6, and $f = 60$, $t = .03$, percentage iron loss equals

$$\frac{7.353}{10^9}\,m\,\frac{b + c + g}{a\,b\,c}\,\beta_m. \qquad (6)$$

It is now seen that the sum of these percentages of losses for which a minimum is desired is of the form

$$y = K_1\,\beta_m + \frac{K_2}{\beta_m},$$

which is a minimum when $\beta_m = \sqrt{\frac{K_2}{K_1}}$, and substituting for K_1 and K_2 their values,

$$\beta_m = \sqrt{\frac{4\,b\,c\,(2 + 2.2\,d + h\,b)\,10^{13}}{d\,m^2\,(b + c + g)}} \qquad (7)$$

Since the maximum efficiency is obtained at that load at which the variable loss equals the fixed loss, a further condition might be imposed that the two above expressions for losses should be equal at the desired point of maximum efficiency.

The expression for the density which allows the minimum

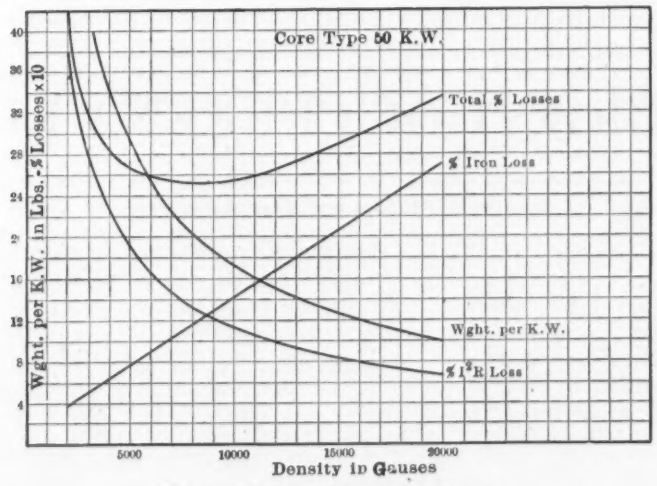


FIG. 4.—LOSSES OF TRANSFORMERS.

losses is independent of a. This would seem to lead to the false conclusion that the density is independent of the size of the transformer; this relation holds only when the proportions remain the same.

If, however, equation (2) and a similar equation for the copper volume are considered, it is seen that the losses vary as the cube of the linear dimensions. The radiating surface varies only as

the square of the dimensions. Hence, as the transformer increases in size, its proportions must be changed to provide greater radiating surface. The expression holds, however, for all values of *b c d*, etc.

Derived from the above equations are the curves shown in Figs. 3 and 4. Fig. 3 shows the relative size, given in values of *a*, and the relative weights per kw plotted against capacity in kw. Fig. 4 shows the manner in which the losses and the weights per kw vary with the density. The loss curves in the second set show a minimum as may be tested by equation (7), and the weight curves show that the greater the density that this minimum is obtained at, the lower will be the weight per kw.

In all of the curves the same proportions are assumed to hold throughout. This cannot be strictly true for the range of capacities and densities considered, but for the purpose of comparison the points desired are none the less clearly brought out.

If the winding of the transformer has been laid out the inductance and hence the reactance drop may be found by integrating over the winding space. It is then possible to completely investigate the effect of doubling the linear dimensions on the several factors.

	Original design.	New design (linear dimensions doubled).
Kilowatt	1	16
Weight per kw	1	½
Per cent total loss	1	½
Per cent exciting current	1	½
Per cent resistance drop	1	½
Per cent reactance drop	1	2
Watts loss ÷ radiating surface	1	2

It is possible, therefore, by this method to entirely predetermine the performance of a transformer before even the drawings are made. In this way a sensible choice for the values of the ratios *b c d* and *k* may be determined and the best possible transformer for any given conditions discovered.

New Telephone Patents.

SCHEMES FOR IMPROVING TRANSMISSION.

Many schemes have now been devised for neutralizing the capacity losses of a telephone line by introducing inductance or its equivalent. The latest patented arrangement is that of S. Kitser, of Philadelphia, who has devised a line made up of alternate sections of copper and iron wire. This he claims improves transmission, although he does not state the length of the sections for practice.

Another patent by the same inventor relates to telephony by the use of induction condensers. These condensers consist of four sets of interleaved plates, in mutual inductive relation. Now, if a branch line is to be led off from a main line at any point, such a condenser is cut into the main line, two sets of plates being connected respectively to the two sections of main line. The other two sets of leaves are connected to the two limbs of the branch line.

Still a third arrangement for improved transmission by the same invention comprises four insulated wires twisted in two pairs. Each pair suffices for one side of the line, one wire of each pair being connected at one end only and left open at the other. Transmission is, of course, effected through the capacity relation of the two wires of each pair. An additional feature is an inductive resistance bridged across the main line at each end of the twisted pair system. The function of this coil is, however, not explained.

C. G. and E. J. Burke use an electrolytic cell in their transmission circuit. One cell is cut into the main line at each end, the receiving instruments being in series. The transmitter and battery at each end are bridged in shunt with the cell.

Letter to the Editors.

Locating Vessels and Storms by Wireless.

To the Editors of Electrical World:

Sirs:—I should like to be permitted to point out in reference to your editorial of the issue of September 22 on the directing of electromagnetic waves in wireless telegraphy, that some suggestions you make have already been put into practice.

Mr. Marconi, some time ago in connection with his experiments on horizontal aerial wires, used a set of eight radiating wires, and by means of a switch succeeded in locating the direction of a British war vessel. He also found that it was possible to receive two simultaneous messages using the same wave length, provided the transmitting stations subtended more than an angle of 40 deg.

He carried out some experiments on the locating of electrical storm centres by means of these horizontal wires, and the writer can vouch for the fact that with 100 ft. of bell wire, some types of receiver and a good ground connection, anyone can locate the direction of an electrical storm, or of a wireless transmitting station, either of which may be many miles away and completely out of sight.

The insulated bell wire can be laid directly on the ground, no elevation at all being necessary.

New York. H. J. Round.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Alternators in Parallel.—Fleischmann.—Various investigators have formerly given formulas for the resonance between the frequency proper of the alternator and the period of the impulses of the prime mover, on the supposition that two perfectly identical sets of machines are running in parallel. In practice, however, it often occurs that two sets of machines are connected in parallel which are different with respect to electrical as well as mechanical conditions. The author gives formulas for this more general case.—*Elek. Zeit.*, September 20

Single-Phase Motors.—Thomalen.—An article illustrated by diagrams in which the author supplements the theory of Sumec of single-phase commutator motors, taking into account the stray field, while ohmic resistance, iron reluctance, and influence of the short-circuited coils are neglected.—*Elek. u. Masch.*, September 9.

Transition Resistance of Brushes.—Salto.—The testing circuit consisted of a source of current, a switch, an ammeter, the first brush to be tested, a slip ring, the second brush, and a regulating rheostat. Various brushes were tested, all being of a composite construction, consisting of carbon mixed with copper, etc. The transition e.m.f. for both brushes together is between 0.4 and 1.1 volts. In the discussion, Arnold remarked that there is probably an electrolytic effect. The metallic ring is covered with a thin film of water which is decomposed when the current passes through it. When the direction of the current is from the metal to the carbon, the metal is oxidized, and the transition resistance is decreased, but it is a fact that with some of the brushes tested the transition resistance decreased when the current passed from metal to carbon, with other types of brushes the reverse was the case.—*Elek. Zeit.*, September 20.

Bearings.—Niethammer.—An illustrated description of an efficient bearing for turbo-generators running at very high speed. This construction is used by the Alioth Co.—*Elek. u. Masch.*, September 16.

Lamps and Lighting.

New Incandescent Lamps.—TEICHMUELLER.—A paper read before the Karlsruhe Electrical Society on the comparative cost of lighting with different electric incandescent lamps. If k is the cost of 1 watt hour in pfennings (4 pfennings = about 1 cent), s the watts consumed per hefner candle, p the first cost of the lamp in pfennings, d the useful life in hours, and n the candle-power of the lamp in hefner candles, then the total cost, y, per hefner candle-hour is $y = s\,k + (p \div dn)$. The following figures are given for different types of lamps:

	Symbol in diagrams.	n watts.	d (cp.)	p (hours)	s (watts per cp.)	First cost per cp-hour.
1*a* carbon filament....	K	25	80	750	50	3.2	0.0027
1*b* carbon filament....	K′	25	87.5	750	50	3.5	0.0027
2*a* tantalum lamp.....	T	25	44	1500	250	1.76	0.0067
2*b* tantalum lamp.....	T′	25	44	1500	400	1.76	0.016
3 Osmium lamp	O	25	37.5	2000	400	1.5	0.008
4 Zirconium-carbon lamp	ZK	25	61	300	75	2.44	0.010
5 Zirconium lamp.....	Z	25	25	800	350	1.0	0.0175
6 metallic filament lamp ("of the future")..	M	25	12.5	1000	200	0.5	0.008

The figures for lamps 1 to 3 are the results of exact tests. The figures for lamps 4 and 5 are those claimed by the manufac-

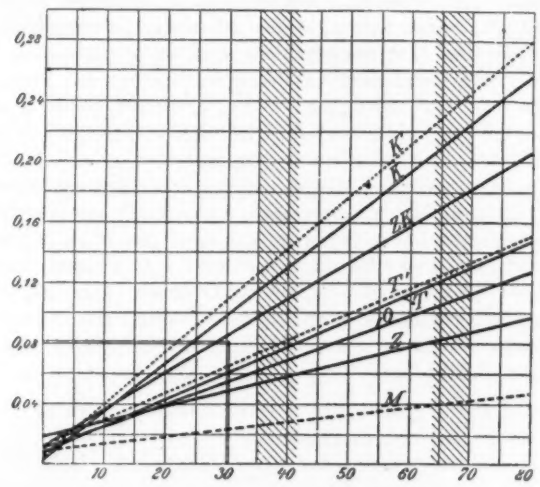


FIG. 1.—TOTAL COST OF LIGHTING.

turers. Lamp 6 is that of Kuzel and the figures represent what the inventor "hopes" to accomplish in future. In Fig. 1 the total cost of lighting with the different types of lamps is plotted graphically for different prices of electrical energy. The abscissas represent the price of the kw-hour in pfennings, while

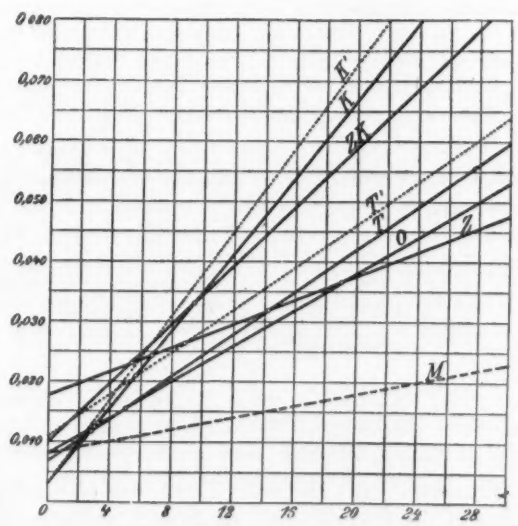


FIG. 2.—ENLARGED VIEW OF SECTION OF FIG. 1.

the ordinates are the cost of the hefner-candle-hour in pfennings. It will be seen that the carbon lamp is more expensive than all other lamps except for extremely low rates for electrical energy which never occur in practice. The point where two lines cross gives the rate for which the two lamps are equally expensive. To show these points more clearly, the left hand corner of the diagram in Fig. 1 is reproduced on a larger scale in Fig. 2. Of the different factors, s, p, d and n the one which has the greatest influence on the position of the curves is s, i. e., the watts per cp.—*Elek. Zeit.*, September 20.

Street Lighting.—KRUESS.—An article giving some formulas on the calculation of street lighting, with applications to measurements of Drehschmidt.—*Jour. für Gasbel.*, September 22.

Power.

Power from Blast Furnace Gases.—A note on the utilization of blast furnace gases at the iron works in the Island of Elba. There are two blast furnaces producing respectively 200 and 350 tons of pig per day. Coke is obtained from a battery of 104 coke ovens arranged in two groups. The gases from both the blast furnaces and the coke ovens are utilized for power purposes, partly directly in gas engines and partly by heating boilers supplying steam engines. The engine room, which is 350 ft. long, contains the blowing engines for the blast furnaces, consisting of two steam engines of 1,200 hp and three gas engines, one of 1,500 hp and two of 600 hp. The generating sets, which produce the power for the different parts of the works, are situated in the same engine room, and comprise three 100-kw, gas-driven, continuous-current sets, one steam-driven, 200-kw set, and an additional set of 350-kw capacity driven by a gas engine is being installed. The blast-furnace gases which feed the gas engines and are used to heat the boilers pass through three Theisen purifiers driven by two 100-hp motors and one 50-hp respectively. The boiler house contains six boilers, arranged so that they can either be heated by the furnace gases or coal fired at times when the furnaces are not working. A five-panel switchboard distributes the current to the lamp and motor circuits. Electric motors are employed for driving the furnace-charging machinery and the pumps of various descriptions which are required about the works. A transmission line, about 2½ miles long, takes power to the pump house from which fresh water for the boilers is obtained. A 40-hp, three-phase motor is used for this purpose supplied at 1,000 volts by an inverted rotary converter and a group of three single-phase transformers. Electric power is further applied to a group of cranes and to a cable transporter at the landing stage for the reception of coal and ore, and to a small electric locomotive.—Lond. *Elec.*, September 21.

Energy Transmission in the Northern Districts of France.—LEBON.—A discussion of the possibility of energy transmission in the Region du Nord in France. In this district the energy would have to be generated either in coal mines from coal of lower quality which cannot profitably be shipped, or by the utilization of the coke-oven gases. The author prefers steam engines to gas engines. Generating sets of 2,000 hp would produce alternating current at 5,000 volts, the voltage to be raised for transmission to 30,000. Some figures are given on the probable cost. With a yearly production of 30,000,000 kw-hours, of which 21,000,000 would be sold, the cost would be 1.1 cts. per kw-hour generated, and 1.58 cents per kw-hour sold.—*La Revue Elec.*, July 15.

Refuse Destructor.—KANDER.—An illustrated description of the municipal refuse-destructor plant of the city of Brünn in Austria. Fifty thousand and five hundred kilograms of refuse are dealt with in 24 hours. The steam raised in the boilers serves for the operation of a 220-kw steam turbine, running at 3,000 r.p.m. It is in parallel with the generators of the central station, which is at a distance of 300 meters. From tests covering several months, it appears that 1 to 1.1 kilograms of steam is produced per kilogram of refuse.—*Elek. u. Masch*, September 9 and 16.

Electric Power in Mines.—ALLEN.—A continuation of his fully illustrated description of the electric equipment of the El Oro mines in Mexico, where electricity has completely supplanted steam as direct motive power. A marked instance of economy in hoisting is described.—Eng. *Mag.*, October.

Power Plant.—DIXON.—In a continuation of his illustrated series on the planning and construction of power plants, he deals with boilers, stokers and chimneys.—*Eng. Mag.*, October.

Gaseous Fuels.—JÜPTNER AND NAGEL.—A discussion of the use of various gaseous fuels, with numerous tables and dia-

grams on the composition of producer gas under different conditions.—*Electrochem. and Met. Ind.*, October.

Traction.

English Tramway System.—An abstract of the last annual report of the Portsmouth municipal tramway system. The total expenses per car-mile were 20.134 cents. The number of car-miles run during the year was 2,111,350, and the kw-hours used per car-mile were 0.98. The number of persons carried through the year was 20,141,674. The percentage of working expenses to total receipts was 44.61.—Lond. *Elec.*, September 14.

British Tramway Plant.—An account of the last annual report of the Municipal Tramways of Salford. "With its large surplus it affords a striking object lesson of the beneficial effects of coöperation on the part of tramway authorities, for it has running powers over some ten miles of length in Manchester, and works jointly with the Manchester Corporation with some lines in Tafford Park." The total length of tramways worked by the Salford municipality is 75 miles. The number of car-miles was 5,228,675, with an average consumption of 1.48 kw-hours per car mile. The gross profit for the year was almost $400,000. The total expenses including capital charges were 19.448 cents per car mile.—Lond. *Elec.*, September 21.

Transporter Bridge.—An illustrated description of the Newport electric transporter bridge in which a traveling carriage runs on the bridge, while from the carriage the platform itself is suspended.—Lond. *Elec.*, September 14.

Canal Towing.—The first part of an illustrated translation in abstract of the German article recently noticed in the Digest on the Teltow Canal and its equipment, and especially on the electric towing system used on the canal.—Lond. *Elec.*, September 14 and 21.

Single-Phase Traction.—An illustrated description of the single-phase Ward-Leonard converter locomotives used in the experiments of the Oerlikon Co. which have been noticed repeatedly in the Digest.—Lond. *Elec.*, September 14.

Installations, Systems and Appliances.

Transformer Stations.—Bernard.—The author first refers to the difference in the space requirements of transformers of equal capacity but different make. He also gives figures on the space requirements of different types of circuit-breakers. He does not favor special houses containing the transformers, but thinks it is preferable to place the transformers in cellars or other parts of existing buildings which are little used.—*Elek. Zeit.*, August 30.

Lightning Arresters.—Ballois.—A summary of theoretical researches and practical observations made during the last year by various investigations with respect to lighting arresters, overvoltages and oscillating discharges in long lines.—*L'Eclairage Elec.*, September 20.

Rheostat.—Hacault.—A mathematical paper illustrated by diagrams giving exact formulas for the determination of a starting rheostat for direct-current motors for cranes, etc.—*L'Eclairage Elec.*, September 22.

Wires, Wiring and Conduits.

Transmission Lines.—Kolkin.—An article in which the author first enumerates the different points which have to be taken into consideration in the design of a power transmission line. He discusses especially from what size of wires a good result may be expected as far as mechanical strength is concerned, and he draws at the same time a comparison between copper and aluminum. He discusses the effect of the wind pressure, and shows that we can expect better results, as regards mechanical strength, from large wires than from small ones, and that wires of less than 40 sq. mm. in copper section, should not be used. In the case of aluminum the limit is 60 or 70 sq. mm. in copper section. He then deals with the influence of fluctuation of temperature, and shows that practically nothing need be allowed for sag for the copper wires, if the average length of spans does not exceed 40 or 50 meters. Figures are then given both for copper and aluminum, and it is shown that with the same coefficient of safety, smaller wires should be given a larger sag than larger wires. If, therefore, wires of various sizes are given the same sag, the small wires will be subject to a much greater strain per unit of section than the large ones. His curves for aluminum show that owing to the great variation in the strain and sag due to fluctuation in temperature, it is quite difficult to string a transmission line of aluminum without exceeding the maximum limit at minimum temperature. As regards strength, he thinks that aluminum does not compare favorably with copper for transmission line purposes, especially where long spans are used. The author finally makes some remarks on construction of poles and cross arms, on guarding and earthing, on insulators and bolts, on lightning arresters, and the phenomenon of over-voltages.—Lond. *Elec. Rev.*, September 14 and 21.

Electrophysics and Magnetism.

Electrolytic Wave Detector.—Austin.—An account of an experimental investigation of the behavior of the platinum point electrolytic detector for electric waves, invented by Fessenden and Schlömilch.—The electrolytic detector is sensitive to alternating currents of low frequency, and with a sensitive galvanometer is capable of detecting a few ten-thousandths of a volt. For the stronger alternating currents used, the breaking down in resistance is approximately proportional to the square of the alternating current. For the smaller currents it appears to vary with a lesser power. With increasing polarizing electromotive force the sensitiveness increases to a maximum, after which it remains constant or decreases. This critical electromotiveforce is not constant, but varies according to the size and condition of the point electrode. Under favorable conditions and with moderate polarization, the detector is equally sensitive to alternating currents with the point electrode anode or cathode, but with the point cathode the action is oftener irregular, the resistance sometimes increasing instead of decreasing. The resistance of the detector for slowly alternating currents varies from about 20,000 ohms to 400 ohms, according to the polarizing electromotive force applied. For rapid oscillations the capacity effect of the point electrode may play a part.—*Bull. Bur. of Standards*, Vol. 2, No. 2, August.

Ozone.—Hower.—Abstracts of two Amer. Physical Society papers, the first of which relates to the production of ozone by a photo-electric current in oxygen. Ultra-violet light was allowed to fall upon a polished platinum knob in an oxygen atmosphere. The knob being charged to about 1,500 volts, the discharge current from it to the earthed wires opposite it was measured by a galvanometer in series. The ozone produced was detected by its effect on a piece of platinum foil. The foil changes its position in the voltaic series when it absorbs O_3. The second paper relates to the production of ozone by Becquerel rays passing through oxygen. Various methods of detecting the cause of the ozone odor observed near radium capsules in air were unsuccessful, but by a special delicate method the attempt was made to show which rays change O_3 to O_2. No effects were observed for beta and gamma rays, while the alpha rays gave a decided positive result.—*Phys. Rev.*, September.

Magnetic Alloys of Non-Magnetic Elements.—Guthe and Austin.—An account of an experimental investigation of the Heusler alloys, the chief purpose being the determination of the form of the magnetization curve of different specimens of alloys, and the determination of the connection between magnetization and magnetostriction, and the relation between magnetostriction and thermo-electromotive force.—*Bull. Bur. of Standards*, Vol. 2, No. 2, August.

Crookes Tubes.—Bacon.—A note giving some hypothetical considerations on the explanation of the phenomena in Crookes tubes.—*Am. Jour. Soc.*, October.

Electric Waves.—Cole.—An article on the use of the Wehnelt interrupter with the Righi exciter for electric waves, and a description of apparatus for the purpose of demonstrating the classic instruments of Hertz on electric waves.—*Phys. Rev.*, September.

Electrochemistry and Batteries.

Electro-Decolorization.—Wiechmann.—An article giving the results of an experimental study in optical sugar analysis.—*Electrochem. and Met. Ind.*, October.

Units, Measurements and Instruments.

Incandescent Lamp Standards.—Dow.—The secondary standards of light now in general use are practically restricted to standard incandescent lamps and flame-standards, usually of the Methven screened type. It is generally considered preferable to use a flame standard, when testing gas lamps of any kind, and an incandescent lamp standard when testing incandescent lamps. If the standard incandescent lamp and the lamp to be tested are run in parallel off the same potential difference, any change in the pressure affects both lamps together, and hence it is quite sufficient if the potential difference is regulated to 1 or even 2 per cent. As a rule, however, two incandescent lamps, even of a similar class, are not affected by a change of potential difference in exactly the same way, and hence the ratio of the candle-power of one to the other is distinctly affected by a change in the potential difference of 5 per cent, or so. With two incandescent lamps of the same type, a change of 1 per cent in potential difference causes an error of something like 0.25 per cent in the determination of candle-power. When comparing a Nernst, tantalum, or osmium lamp with a standard incandescent lamp, run in parallel with it off the same potential difference, the exact regulation of this potential difference becomes much more important. For, while the candle-power of the incandescent lamp varies with about the seventh power of the potential difference, the candle-power of tantalum and osmium lamps appears to vary with about the fourth and fifth power, respectively, and the candle-power of the Nernst lamp, on account of the iron wire resistance in series with it, is practically independent of small variations in the potential difference. The following figures give the results of a comparison of a tantalum lamp with a standard carbon filament incandescent lamp run in parallel with it off the same potential difference for several values of the potential:

Volts.	Ratio of candle-power: Tantalum lamp to Carbon lamp.
91.2	0.576
95.0	0.530
97.0	0.505

In this case a difference of 1 per cent in potential difference

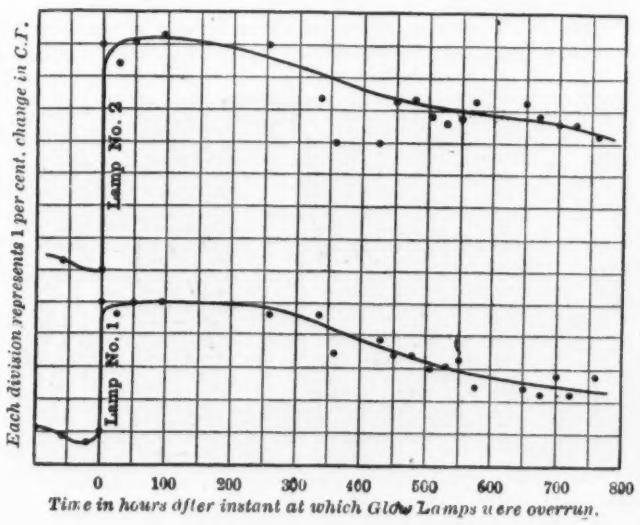


FIG. 3.—EFFECT OF OVER RUNNING.

makes a difference of as much as 2.5 in the candle-power. If two incandescent lamps—even two lamps having precisely the same type of filament—be compared at distances varying from 1 meter up to 3 meters, the results tend gradually to change as the distance increases. In spite of every care in the centering of the lamps and the photometer, differences are almost always found, especially if the lamps are of quite different types. For accurate work, a certain distance between the lamps compared should be agreed upon. Standard filaments should have filaments of the simple horseshoe type, lying entirely in one plane. When an incandescent lamp standard is used to study the variations of a flame standard, the potential difference must be very exactly known. Contact resistances in the lamp holder may possibly give trouble, especially if the resistance of the lamp is low. At the Reichsanstalt the results of contact troubles are entirely avoided by measuring the current through the lamp instead of the potential difference. Several advantages of this method are pointed out by the author. He then refers to what he calls the hysteresis effect. If the potential difference across a lamp be maintained for a short time at a higher value than that at which the lamp is normally run, both the current and the candle-power are usually perceptibly higher than before, when the potential difference is brought down again to the usual value. As a rule, when left alone a lamp tends gradually to return to its former state, the time of recovery depending upon the severity of the strain to which it was subjected. Fig. 3 shows the recovery of two 100-volt, 50-cp lamps, which were used as secondary standards. These two lamps were always used at a potential difference of 95 volts, but one day they were accidentally run at—probably—nearly twice this value for a few seconds. The filaments, however, did not give way, and the lamps were immediately retested, when it was found that their candle-powers had increased by about 4½ and 7 per cent, respectively. A record was kept of the candle-powers of these for about a month afterwards. They were run at 95 volts, and were always compared in exactly the same position, with the same standard. The gradual fall of candle-power during the month showed that the lamps were gradually returning to their original state, but at the end of the month they were still about 2.2 and 4.2 per cent, respectively, above their former values. The author points out that this recovery of lamps is of interest since it may affect the question of the ageing of standard lamps before use. He thinks that the tantalum lamp and Kuzel's metallic filament lamps may prove very valuable as standard lamps.—Lond. *Elec.*, September 14.

Speed Tests.—DRYSDALE.—The conclusion of his illustrated serial describing accurate methods of measurement of speed, frequency and acceleration. In his last installment he deals with acceleration measurements.—Lond. *Elec. Rev.*, September 14.

Self-Inductance of Coils.—ROSA.—A mathematical paper giving formulas for calculating the self-inductance of single-layer coils.—*Bull. Bur. of Standards*, Vol. 2, No. 2, August.

BOOK REVIEW.

PHYSICS. By Charles Riborg Mann and George Ransom Twiss. Chicago: Scott Foresman & Co. 453 pages, 237 illustrations. Price,

This manual, written for use in high schools, covers the whole ground of elementary physics. If novelty of treatment is a recommendation, this text-book is recommendable. We cannot, however, think the omission of mirrors, of the electrophones, the astatic and tangent galvanometers a justifiable sacrifice to the spirit of novelty. There is a noticeable freshness in the mode of presentation which is, indeed, calculated to awaken the interest of the student; but interest is not everything, nor is it the end for which physics is taught. Accuracy and method are of greater value.

The illustrations are numerous, many of them are excellent, some, however, are far-fetched and a few are puerile. Ohm's law is said on page 293 to be expressed by the equation, $Amperes = \frac{Volts}{Ohms}$. Here, meaning and accuracy are sacrificed to brevity; nor is the above equation Ohm's law at all.

The questions and problems appended to the chapters as well as the suggestions about works to be consulted and biographies to be read form an excellent feature of the work. It was *Carlisle* not Carlyle (page 218) that effected the electric decomposition of water in 1800; Oersted's discovery was made in 1819, not 1816. These flaws are, of course, mere *lapsus calami*.

That this manual is up to date may be seen by the paragraphs on radium and the size of the electrons; it is, if anything, too comprehensive; we would like a little more depth and less surface.

The Decker Primary Battery.*

By Prof. Francis B. Crocker.

On May 16, 1888, the writer read before the American Institute of Electrical Engineers a paper on "The Possibilities and Limitations of Chemical Generators of Electricity." This paper discussed and compared the various types of primary cells. It was shown that about one pound of zinc and a few pounds of other materials were capable of producing one horse-power-hour and the statement was made that "the possibilities are very, very great." On the other hand, little or no progress had been made with the primary battery for almost half a century, so that the outlook was discouraging, especially in regard to its structure and handling. Hence the conclusion was reached that "the *apparatus* is at fault, not the *chemical action.*" (Italics in the original.) Let us consider briefly the principal historical facts.

The original form of primary battery or "couronne de tasses," which was the first known source of electric *current* in contradistinction to static *charge,* was invented by Volta in 1800. Amalgamation of the zinc was introduced by Sturgeon in 1830. The two-fluid type of primary cell with porous cup to separate the fluids was invented by Daniell in 1836. The use of nitric acid as an electronegative fluid or "depolarizer" more powerful than the copper sulphate of the Daniell battery was due to Grove and dates from the same year (1836). In the Grove cell a platinum negative plate is employed to withstand the action of the nitric acid, and Bunsen in 1842 substituted carbon for this expensive metal. Poggendorf in 1842 devised a single-fluid cell in which a solution of potassium bichromate mixed with sulphuric acid was used as a depolarizer instead of the nitric acid of Grove, thereby avoiding the obnoxious fumes without material sacrifice of power. One is at a loss to point out any radical or even important advance in primary batteries since the time of these fundamental improvements. In other words, so far as the types now on the market are concerned, they are not substantially better than what might have been obtained more than sixty years ago. This is all the more remarkable when it is remembered that practically all the modern applications of electricity with the exception of the telegraph have been made since 1876, a period only one-half as long during which the dynamo-electric generator has been developed from one horse-power to ten thousand, its efficiency and mechanical construction being vastly improved at the same time. It should be noted that the Leclanché cell (with sal ammoniac solution) was brought out in 1868, and the so-called "dry" batteries about 20 years ago; but these types are applicable only to intermittent service such as ringing electric bells, and even for short periods are incapable of giving any considerable electric power. Hence they constitute a special class adapted to perform merely light duties, and should not be included or compared with batteries capable of operating electric lights and motors. The Lalande battery was invented in 1881 and is now manufactured and used to supply considerable amounts of electric power; in fact it is practically the only type of primary cell now employed to any extent for this purpose. Definite statements and figures in regard to this battery will be given later.

The quotation from the writer's paper in 1888 to the effect that "the *apparatus* is at fault not the *chemical action*" applies equally well to the primary battery of 1906 so far as any types now upon the market are concerned. They usually consist of separate glass or porcelain jars clumsy and liable to breakage; electrical connections are made by wires and binding posts, inconvenient and exposed to corrosion as well as to mechanical injury; with no way to supply fresh liquids except by the laborious and sloppy process of pouring them into each cell separately. A picture of a primary battery of 1850 compared with one of 1906, would show little difference in favor of the latter, certainly nothing radical. On the other hand, compare a dynamo of 1878 with one of 1906, an interval exactly half as long! This Chinese progress of the primary battery which was discouraging in 1888, became more so as time went on, and the opinion of the writer if expressed in 1904, would not have been much more favorable than in 1888, since there was little or nothing upon which to base hope of material advance in this direction. The principal weak points of the primary battery are first, high internal resistance limiting its power and efficiency; second, weakness and looseness of its parts exposing them to breakage or derangement; third, exposure of the electrical connections to corrosion as well as to mechanical injury; fourth, the great inconvenience and the likelihood of spilling the liquids when a battery is being emptied of an old charge or supplied with a new one; fifth, the high cost of the materials as well as labor required for recharging. Practically none of these five difficulties has been overcome or even mitigated so far as published information goes. Recently, however, it has been the writer's good fortune to examine and test a primary battery in which the first four of these defects are actually overcome and there is good prospect that the fifth will be largely reduced.

Construction and Operation.

The battery to which I refer has been developed during the last two or three years by Mr. F. A. Decker, of Philadelphia. It is of the two-fluid type with zinc plates immersed in dilute sulphuric acid and graphite plates in a solution of sodium bichromate and sulphuric acid. The materials and chemical action are, therefore, similar to those of other batteries, the original features being found in the *construction* of the parts and the manner in which they are put together. The size and number of plates employed in each cell depend upon the current required, but ordinarily there are two or three flat zinc plates about 5½ in. wide by 9½ in. high, each weighing about 1 lb. Each zinc plate and the dilute sulphuric acid surrounding it are contained in a flat porous cup. In order to form such a cup two unglazed earthenware plates with thickened edges and diagonal strengthening ribs are shaped separately in steel moulds, a special clay mixture being employed to obtain any desired porosity. These plates are made extra thick to prevent warping in burning and produce true flat surfaces and straight edges. They are then united to form a flat cup, after which it is ground down on each surface to the desired thinness. In point of fact the finished walls are very thin, so that light will show through them, which enables the degree and uniformity of thinness to be readily determined. The grinding operation involves little time or skill, being performed by half-grown boys. In this way a flat porous cup is obtained perfectly true on all sides and with walls much thinner than could possibly be made if it were attempted

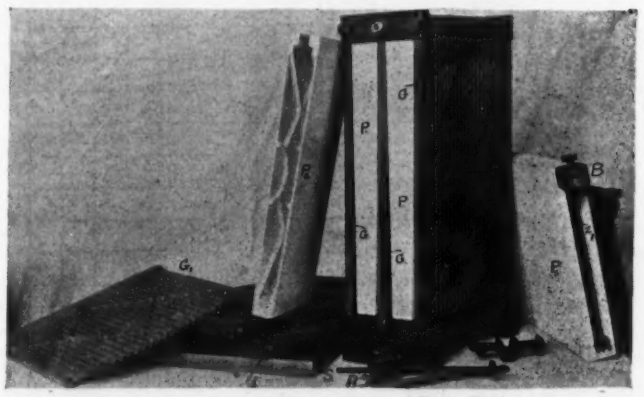


FIG. 1.—PARTS OF THE DECKER BATTERY.

to form a complete cup in the first place. At the same time this cup is amply strong, no breakage being found to occur even in automobile service. Two of these porous cups, *P P,* are shown in Fig. 1, in combination with three graphite plates, *G G G.* and at P_1, with a zinc plate, *Z*; also one of these porous cups sawed through vertically is seen at P_2, the strengthening ribs on the interior surfaces as well as the thickened edges being visible. The exceeding thinness of the walls of these cups tends to reduce the internal resistance to a minimum for any two-fluid cell, and the fact that these walls are true permits the graphite and zinc plates to be placed close together, and thus to minimize the resistance. By actual test the resistance is only .013 ohm for a cell of the kind described with two zinc and three graphite plates, all

* A paper read before the American Electrochemical Society, Oct. 8, 1906.

connections and the resistance of the plates themselves being included.

The negative plates are of graphite, being corrugated so as to offer large surface for the free action of the depolarizer, and also provided with thickened edges and diagonal ribs to give them strength as well as to decrease their electrical resistance. Three of these plates are represented at *G G G* in Fig. 1, as already stated, and half of another is seen at G_1, having been sawed in two to show the corrugation.

The space around the porous cups and graphite plates is filled with the depolarizer consisting of a solution of sodium bichromate mixed with sulphuric acid, which is introduced into the containing vessel of hard rubber as explained later. One of these vessels comprising four cells is shown in Fig. 2. In order to assemble a battery the two porous cups, *P P*, in Fig. 1, each containing a zinc plate, with the three graphite plates, *G G G*, are placed in one of the cells of the containing vessel in Fig. 2,

FIG. 2.—CONTAINING VESSEL COMPRISING FOUR CELLS.

other similar sets being put in the other cells. To supply dilute sulphuric acid to the porous cups each one communicates, through a small opening at the bottom, with a conduit in the base of the containing vessel. The two outlets of this conduit in each cell are shown in the bottom of the containing vessel in Fig. 2. The openings of the two porous cup are respectively connected to these outlets by means of vulcanized joints free from leakage or acid action. The conduits leading to the various cells are branches from the main conduit that extends the entire length of the containing vessel under one side. The depolarizing fluid is supplied by a similar set of conduits, but in this case it is sufficient to have one simple outlet in each cell. It is objectionable to have direct electrical connection between the various cells through the liquid contained in these conduits because a certain short-circuiting or leakage of current would occur. This is reduced to an insignificant amount in the Decker battery by making the branch conduits of considerable length and small cross-section. A containing vessel of four cells with the upper part cut off is shown in Fig. 3. The two outlets in each cell which supply the two porous cups with dilute acid are connected to the main conduit, *C*, by a branch conduit extending across the cell. Similarly the outlet that feeds each cell with depolarizer is connected by a branch conduit to the main conduit, C_1, on the other side. In this way the total length of the liquid connection between the cells is made very considerable. The main and branch conduits with their connections to each other and to the cells and porous cups are composed of hard rubber all vulcanized together, forming what has been aptly called an irrigation or drainage system, since it performs both functions. The several cells that make up the containing vessel in Fig. 2 are also vulcanized together, so that the battery with all its cells, conduits and porous cups, constitutes one substantially integral mass with no loose joints or parts. The graphite and zinc plates as well as their connections are also held very firmly in place so that the battery as a whole may properly be claimed to be an integral structure or unit.

The electrical connections in batteries have always been a source of much trouble, being difficult to make and still more difficult to maintain because of the corrosive action of the liquids. In the Decker battery the connection to each graphite plate is made by a brass screw extending several inches into its thickened upper edge. One of these screws is shown at *S* in Fig. 1, and the end of another is seen projecting from a carbon plate at *s*. When the plate is in place this end of the screw passes out through a hole near the top of the containing vessel, being held firmly by a nut on the outside. The connection to the zinc plate is made by means of a long tapering zinc plug inserted in a zinc block, *B* and B_1, in Fig. 1, enabling the plate to be readily renewed, at the same time making a good mechanical as well as electrical joint. This zinc block is held in place by a screw passing through the wall of the containing vessel with its head outside. The carbons of one cell are connected together and to the zincs of the next cell by a brass strip placed under the nuts and heads of the screws. We see, therefore, that connection is made to the graphite plate (impregnated with paraffin along its upper edge to make it impervious) by a long screw embedded in it, and giving extended contact surface. The zinc plate, plug and block being all of the same material are free from voltaic action and all the rest of the connections, including those between the plates of each cell as well as between the cells, are *external* to the containing vessel. Hence, all trouble is avoided from corrosion, loose connections or poor contacts of

FIG. 3.—CONTAINING VESSEL WITH UPPER PORTION CUT AWAY.

any kind, this statement being borne out by experience. It is this care as to correctness of design and perfection of details that frees this type from the serious defects in structure and operation that have characterized primary batteries for 106 years.

The two fluids are caused to run into or out of the battery by connecting the two main conduits, *C* C_1 (Fig. 3), already described, with two supply tanks by means of rubber or lead pipes, each main conduit being provided with a socket or nipple to which the pipe is attached. The fluids may be caused to flow by a pump or siphon or by raising and lowering the supply tanks. A neat method is to force air into the supply tanks, thereby driving the liquids into the battery, allowing them to run back by gravity. This is the arrangement represented in Fig. 4, a battery of 16 cells, being supplied from two tanks below. The switch above on the right not only closes the circuit and lights the lamps, for example, but also turns air pressure into the tanks, thus filling the battery. The large cell on the floor to the right is a type having 10 zinc and 11 graphite plates, being capable of giving 120 amp. for 6 hours at an average of 1.7 volts. It is intended for heavy work, having a lead-lined containing vessel of wood.

RESULTS.

The results obtainable from the Decker battery are shown by tests made personally by the writer. A cell of the form described having two zinc and three graphite plates, was discharged for a period of 5¼ hours at 24 amp., the external potential falling from 1.9 to 1.3 volt. In other words, the cell gave 126 ampere-hours at an average voltage of 1.73, or 218 watt-hours. The cell was then shaken so as to stir the liquid and gave 24 amp. for 53 minutes longer. This corresponds to the condition that would exist in electric vehicles, boats and train lighting. The total output, therefore, was 147 ampere-hours at 1.684 average voltage, or 247.55 watt-hours. As the complete cell weighed 16 lb. 14 oz., including all solutions, connections, etc., the output was 14.7 watt-hours per lb. of total weight, which is an output about twice as great as that obtained from the standard types of storage battery now manufactured and used. To put these figures in simple form for ordinary business purposes, it may be stated that a cell weighing 17 lb. gives 150 amp.-hours at an average of about

1.7 volts, or about 250 watt-hours, which is equivalent to one-third of a horse-power-hour. The output is nearly 15 watt-hours per pound of complete cell.

In this connection it should be remembered, however, that the liquid constitutes only about one-half the total weight of the battery, hence it would be possible to carry in tanks an additional amount of solution equal to the weight of the battery, in which case we could obtain three times as much electrical energy with only twice the total weight. In other words, the output would be 22.5 watt-hours per pound, which is about three times that obtainable from a standard storage battery. It would not be necessary to renew the zincs because they are sufficiently thick to be equivalent to three or more charges of liquid.

A second advantage of the Decker battery compared with the storage battery in addition to this large saving in weight is the facility of recharging it by simply running out the liquids and refilling with fresh solutions, which can be done in five or ten minutes compared with five hours or more required for recharging a storage battery.

A third advantage of the primary battery is the fact that it has no limit in voltage beyond which the discharge cannot safely be carried. If desired it can be discharged indefinitely until there is practically no power left. In the case of the storage battery on the other hand, it is very objectionable to discharge below 1.6 volt per cell on account of the danger of "sulphating" and serious injury to the plates.

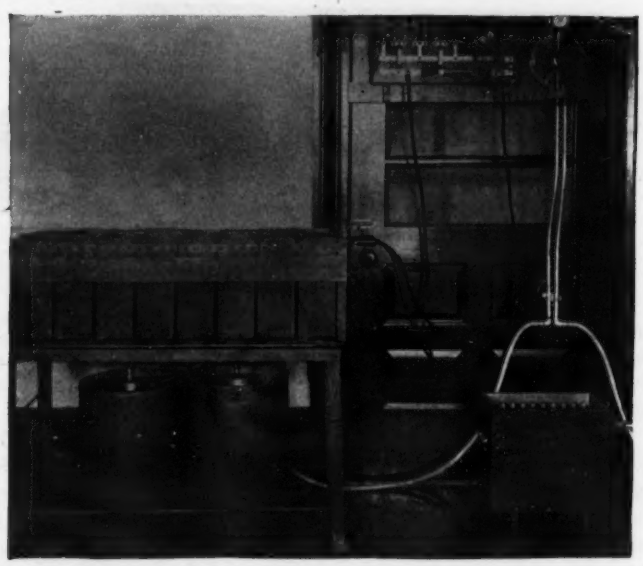


FIG. 4.—SIXTEEN-CELL BATTERY WITH SUPPLY TANKS AND CONTROLLING APPARATUS.

A fourth advantage of the primary type is the fact that it is not necessary to recharge it immediately after the discharge, whereas it is decidedly objectionable to leave a storage battery in a discharged state for any length of time.

The principal, if not the only disadvantage to be considered, in comparing the Decker battery with the storage battery, is the rather high cost of recharging the former.

COST OF OPERATION.

The weight of zinc, sulphuric acid and sodium bichromate required to give one horse-power-hour in the Decker battery, assuming all materials to be thrown away after being used once, would cost about 35 cents, which is a high rate. It should be remembered, however, that the several important advantages which have been pointed out will offset this item for many purposes and in many places. It would be absurd, of course, to claim that any primary battery can compete directly with the dynamo driven by steam, gas or water power where such a source is available. There are applications, however, for which it is not practicable or convenient, and these will be set forth later. Furthermore, the first cost of the battery is not high and its depreciation is very small. It is expected, also, that the cost of the materials required for recharging will be much reduced by recovering or regenerating them. That is to say, the liquids drawn off from the battery after it is discharged are treated electrolytically in suitable cells to regain the zinc and reoxidize the chrome solution. In this way there would be very little actual loss of materials and the cost of operation per horse-power-hour would be simply the cost of the electrical energy required for regenerating the materials plus the labor involved. The latter would not be great because the liquids could be transported in the tanks in which they are sent out and can be caused to flow through pipes into or out of the electrolytic cells. In this way the operation of recharging this primary battery would not cost much more than recharging a storage battery. The only real difference in principle between the two cases is the fact that the charging or regeneration and discharging of the former take place in different cells; whereas both operations are performed in the same storage cell. So far as transportation is concerned the primary battery would have decided advantages. First, because tanks of liquid are much more easily portable than storage batteries, and second, the liquid for the primary battery weighs only one-quarter as much as an equivalent storage battery which must be carried as a whole, or say one-third as much including weight of tanks.

APPLICATIONS.

An electric vehicle cannot be connected with a dynamo except through a trolley wire or other fixed conductor. Where such connection is not feasible, as in the case of cabs, pleasure vehicles, trucks, delivery wagons, etc., the only electrical source of power now available is the storage battery. The advantages of the Decker compared with the storage battery have already been set forth and they are certainly very substantial. The higher cost of the electrical energy which is the only disadvantage of the former, would probably be a small matter in many cases. The other items of expense in operating an electric vehicle or gasoline automobile are so high, for example, the cost of tires, that a little higher rate for electrical energy would often be insignificant or more than overcome by advantages gained. Furthermore, the depreciation of a storage battery is much greater than that of the Decker battery. A vehicle storage battery has a life of about 5,000 miles after which the renewals would cost at least $120, or 2.4 cents per mile; that is, more than the cost of the electrical energy at 10 cents per kw-hour. Hence several of these incidental items are higher than the cost of the energy itself. What has been said in regard to the electric vehicle would apply also to electric boats, the general conditions of service being similar.

For the purpose of lighting railway trains the advantages of the Decker battery already explained would all apply. In fact, it seems that this application is one of the most favorable of the various possible uses to which this battery may be put. The equipment could be much more easily applied to the cars than is possible with the electric generator and storage battery combinations now used, it being sufficient merely to carry the battery and tanks of liquid and not necessary to attach and connect electrical generators or other machinery. Furthermore, the power is obtained without any drain upon the power of the locomotive, which is sometimes taxed to its utmost with a heavy train and steep grades.

There are also many places in the country where it is either not possible or not convenient to obtain electrical energy by direct wires from a central station or electrical generating plant; in such cases this primary battery would afford a simple and convenient source of supply. Electric lamps for reading and for sick rooms, electric fans, advertising lamps and devices, dental motors and many other pieces of electrical apparatus may be operated in this way. The cost of electrical energy with regeneration of the materials would not be much if any greater than the rates charged by electric lighting companies in some of the smaller towns.

The Lalande type is the only primary battery now on the market, from which any considerable current in amperes or power in watts can be obtained. One of these cells having approximately the same total watt-hour capacity as the Decker cell described weighs 25 lb., compared with 17 lb. It is not practicable, however, to discharge it at even one-eighth the rate in watts obtainable from the Decker cell, the latter weighing

only about two-thirds as much. It is also a fact that the voltage of the Lalande type when giving considerable current, is very low, falling to .3 or .4 volt with currents of 10 or 12 amp., whereas the Decker cell, weighing only 17 instead of 25 lb., gives 24 amp. at 1.9 volt initial and 1.7 volt average.

One might think that at 35 cents per hp-hour, the cost of energy given for the Decker cell without regeneration would be prohibitive, but nevertheless the cost of about $5.30 for the same amount of energy for cells of the Lalande type has not been found prohibitive, since batteries of this class have been and are being used in large numbers.

It is evident from the statement of facts contained in this paper that Mr. Decker has made a remarkable advance in the primary battery art.

Trolley Harps and Retrievers.

Standard as the art of trolley operation and line construction has become, room is found from time to time for valuable refinements in the art, adding to the safety, economy and efficiency of the system. Among such improvements may be classed the new trolley harp and the latest trolley retriever of the Central Laboratory Supply Company, of Lafayette, Ind., recently patented and put on the market.

The distinctive features of the harp illustrated herewith lie in the closed lower part, which has several advantages over the ordinary open type. First, when the wheel leaves the wire, and is drawn down by hand or by a retriever, it is impossible for the harp or wheel to catch on the wire in its downward movement; second, with the ordinary form of harp, the rain and moisture collected by the wheel from the wire, together with the oil, finds its way down the rope. In summer the rope is wet and greasy; in winter it is frozen stiff. Water entering the retriever from the rope in cold weather is frozen and stops its action. In the harp shown the water is discharged at a point below the rope fastening, keeping the cord clean and dry.

The trolley retriever consists of few parts; is constructed almost entirely of steel, with cast aluminum case, making it light in weight and pleasing in appearance. The mechanism can be readily exposed for adjustment or inspection. The running

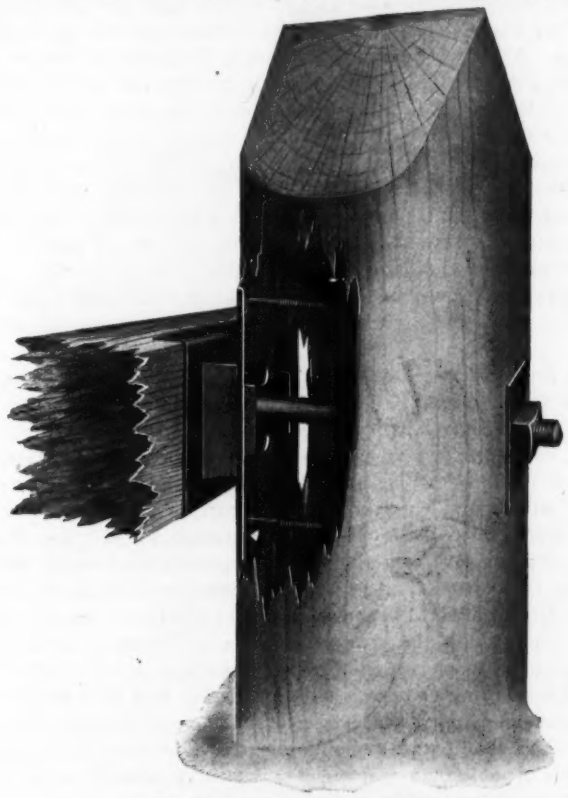
FIG. 1.—RETRIEVER ASSEMBLED.

spring is of sufficient strength to keep the cord taut, and the adjustments can be accurately made.

The retriever will not trip unless the trolley leaves the wire. The ratchet has 12 notches, whereas other retrievers have usually 2, making it impossible for the drum to rotate but 1/12 of a revolution before the pawl engages the ratchet. When the wheel leaves the wire it is immediately drawn down and held. The retriever is automatic setting; is easily detached from the car, and is held firmly in place. Both of these devices have been thoroughly tried out on interurban and city lines.

A Metallic Support for Cross Arms.

A device of special interest to constructors of power transmission lines, interurban railways and even electric light systems



METALLIC SUPPORT FOR CROSS ARM.

is shown on this page. The device is a steel gain and is clearly illustrated herewith. In this illustration it will be seen that the cross arm is attached to the pole by means of a metal fixture composed of two plates engaging each other and at the same time engaging the cross arm and the pole. The curved steel plate embraces the pole, while the gain plate, which is provided with projecting braces or tongues supports the cross arm. The tongues of the gain plate pass through apertures in the pole plate and fasten into the pole. Shoulders on these braces clamp against

FIG. 2.—PARTS OF RETRIEVER.

the pole plate and afford a most rigid support for the gain. The pole plate has normally a greater radius than the largest pole top and when drawn into place not only conforms closely to the circumference of the pole, but by pulling the gain towards it as it is clamped into place, provides sufficient spring tension to compensate any shrinkage in the pole or cross arm.

Referring to the illustration, it will be seen that the device is attached by one through bolt, which passes through the cross arm, the gain plate, the pole plate and the pole, and is held by the usual square washer and nut. The pole plate is afforded an additional support by the two lag screws, one placed above and the other beneath the gain.

The advantages derived from the use of the steel gain are readily appreciated. The device when properly fastened in place supports a five or six-foot cross arm so rigidly that cross arm braces are unnecessary. This fact in itself is a decided advantage, as the cost of cross arm braces and the cost of cutting a gain are saved. A further saving is effected in mounting the arm with this steel gain, as the relation of the gain to the pole plate is such that the arm is brought into perfect alignment without the usual sighting and without the use of a square. Still another advantage is derived from the fact that this steel gain when in place adds to the strength of the pole instead of reducing the strength at a point where it is most needed. A gain cut in a pole one inch, or even less, greatly reduces the strength of the pole, while this steel gain tends to brace and strengthen the whole structure. It also has the effect of a back brace, as it will resist a lateral strain that ordinary braces, no matter how heavy, cannot withstand.

While the advantages of construction are of great importance, the most valuable feature of the device comes into sight after the power transmission line, or whatever other line the device is used on, has been put into operation. The use of a single metallic cross arm brace or a pair of metallic braces causes a noticeable loss of current by leakage. A wire carrying a high-potential current, even when mounted on the most approved type of insulator, lies not far from that point on the cross arm to which the brace is connected. Even in dry weather there is likely to be a certain amount of leakage from the conductor on one side of the arm through the cross arm brace or braces to the other conductor on the opposite side. This leakage is greatly increased during damp, rainy or snowy weather, and it has been the study of a great many electrical engineers to overcome this loss of energy. The steel gain by eliminating the cross arm braces eliminates this troublesome feature in power transmission work and makes it possible to use a shorter arm with safety.

Although the steel gain is new so far as heavy work is concerned, a smaller and lighter gain has been used in telephone and electric light work for a little more than two years. In the lighter branches of construction it affords the same advantages as are set forth above, and it has proved itself an economical and most satisfactory support for cross arms. Various sizes are made to accommodate telephone and electric light arms, as well as the heavier arms for power transmission lines. The pole plates of the lighter gains are not extended as are those shown in the illustration, but they are sufficiently long to afford a rigid support.

When shipped from the manufacturer the two plates are assembled, the tongues of the gain plate engaging the pole plate so that the device may be considered as a single unit. Both the pole plate and the gain plate are made of No. 12 Bessemer steel, and the weight of the large gain for 5-in. arms is approximately 3½ lb. The Steel Gain Manufacturing Company, of Chicago, are the makers of this device, which they furnish either plain or galvanized, as ordered.

Linemen's Portable Telephone Testing Sets.

The Holtzer-Cabot Electric Co., of Brookline, Mass., and Chicago, Ill., has recently developed and placed upon the market two new types of portable testing sets for linemen's use, known as the "Universal" and "Watchcase Receiver" types. The type shown in Fig. 2 was designed to meet the practical requirements of telephone linemen and embodies everything required in all classes of telephone line testing, thereby doing away with the necessity of having separate sets for series and bridging work. The case, which is substantially made and protected by metallic corner shields is provided with a carrying strap which has a snap catch so that the box may be quickly suspended from the cross-arm or any projection by the use of one hand. The door is held closed by an automatic catch which is released by a flush push button preventing the case from being accidentally opened. It is provided with a hand microtelephone combining the Holtzer-Cabot bipolar watchcase receiver and standard granular carbon transmitter, which enables the line-

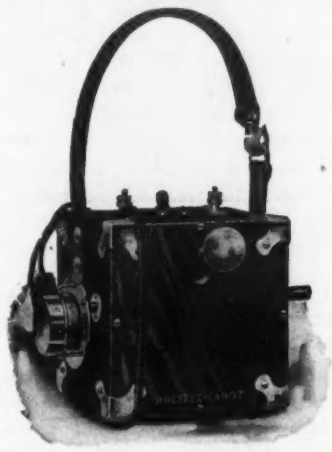


FIG. 1.—PORTABLE TELEPHONE TEST SET.

man to talk with ease in any position, as it may be taken from the box and the door closed, thus having a great advantage over testing sets in which the transmitters are mounted on the cover. The mouthpiece is metallic, so that it will withstand hard usage, and in the handle there is a push button which throws the batteries out of circuit when not in use, thus prolonging their life. A generator of the magneto type gives alternating current for signaling subscribers, or pulsating direct current for ringing the switchboard, this being controlled by a two-point switch inside the cover. There is also a push button to shunt out the ringer on heavily loaded lines. Each set is equipped with standard 1,000-ohm ringer, which may be shunted out of circuit when desired by means of the push button. The induction coil is of the standard square head type with a resist-

FIG. 2.—PORTABLE TELEPHONE TEST SET.

ance of 100 ohms. Two dry batteries are used which are of long life by reason of the precautions taken to minimize the current used. The binding posts are conveniently located on the top of the case and may be manipulated by one hand without a screw driver or tool of any kind. Aside from being a compact testing set, the "Universal" is a complete portable telephone, and can be used to excellent advantage on isolated steam and electric railroad lines for communicating with terminals or branch stations.

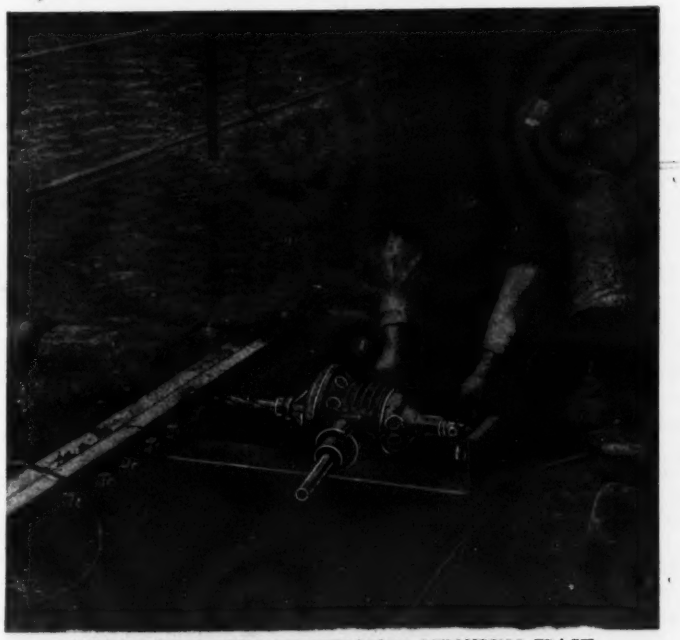
The essential features of the receiver type, shown in Fig. 1, correspond closely to the "Universal" type. The case has

protected corners and a carrying strap furnished with a clasp so that the box may be quickly suspended. The receiver is of the watchcase, bipolar pattern and is used for both talking and listening. A valuable improvement is the addition of a push button in the receiver, which normally keeps the receiver circuit open, but when pressed closes the circuit. While communication is established the button is held closed by the thumb of the operator, but as soon as the conversation is through the receiver may be laid down and the circuit is automatically opened. The receiver is wound to 150 ohms and is enclosed in a metal case making it a substantial instrument for outdoor use. The generator is equipped with a combination spring and two-point controlling switch enabling it to give alternating or pulsating direct current for signaling the subscribers or the central switchboard. The resistance of the ringer is 1,000 ohms and may be shunted if desired when used on a heavily loaded line. This set is equally serviceable on both series and bridging circuits.

Portable Electric Tools for Rail-Bonding.

A new portable electric drill, to operate on street railway circuits, has just been placed on the market by the Chicago Pneumatic Tool Company, and is attracting marked attention. Its 110 and 220-volt drills have been favorably known to the trade for the past two years or more, and the mechanical features of these drills have been retained in the new drills.

The accompanying cut shows a 550-volt drill in operation on re-bonding work, drilling ⅞-in. holes in hard steel rails. A fair idea of its size can be obtained by comparison with the men in the picture. This size of drill weighs 35 lb., and will drill a ⅞-in. hole through an ordinary rail in less than two minutes. The electrical parts are built to operate at 500 to 650 volts without external resistance. A quick-break barrier type switch, many times the normal ampere rating of the drill, is mounted directly on the housing. The insulation is of the very highest type



SINGLE MOTOR DRILL IN OPERATION REBONDING TRACK.

throughout, and the drills are built to withstand the conditions of severe service in street railway construction and maintenance. Special precautions have been taken to prevent any danger of shock to the operator should any part of the windings become grounded, and in the hands of operators of average intelligence this danger has been eliminated.

The above company has also brought out a portable electric grinder wound for 500 to 650 volts, for use on railway work. This grinder weighs 20 lb. and drives an 8-in. diameter by 1¼-in. face emery wheel at a speed of 2,500 r.p.m. The usefulness of the above tools will be obvious to all street railway men. The apparatus can be seen in operation at the convention of the American Street & Interurban Railway Manufacturers' Association, at the State Fair Grounds, Columbus, next week.

Electrose High-Tension Insulators.

In the preceding issue a cross-sectional view was shown of the Electrose high-tension insulators used on the transmission line to Fort Erie of the Canadian Niagara Power Company, the illustration being taken from a paper read by Mr. Harold Buck, chief electrical engineer of that company, at the recent annual

FIG. 1.—PHOTOGRAPHIC VIEW OF INSULATOR.

convention of the Canadian Electrical Association. We illustrate herewith a similar insulator and pin by the same manufacturers, the Electrose Manufacturing Company, 127 North Tenth Street, Brooklyn, N. Y. The insulator shown is of the same type as that used on the Niagara line; the latter, however, used a malleable iron pin, while the pin shown in this case is of electrose. This type of pin is used by the Niagara Falls Power Company.

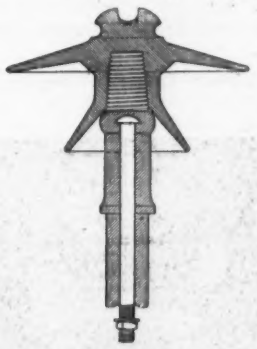


FIG. 2.—CROSS-SECTIONAL VIEW OF INSULATOR.

The manufacturers also make electrose high-potential insulators having the pin or support integral with the insulator, which form obviates the troubles often experienced with insulators mounted on separate pins. Fig. 1 is a photographic reproduction showing the insulator and pin complete and Fig. 2 illustrates the details of the pin.

Motor-Generators in Trolley Sub-Stations.

The power plants and systems of the Columbus, Ohio, Railway & Light Company are among the most modernly equipped stations in the Central West, embodying as they do all the newest and latest practice in equipment and operation. The company was incorporated in Ohio in 1903 and acquired by lease the Columbus Railway Company and the Columbus Edison Company. On July 1, 1906, the company also acquired operating control of the Central Market Street Railway, which was one of the Appleyard properties, but was obtained by the Ohio syndicate at a receiver's sale. The Central Market Street Railway owns 16 miles of track and leases 15 miles. The Columbus Railway & Light Company owns 107 miles of track, making a total of 138 miles in the combined system.

The system consists mainly of broad-gauge lines on which 331 cars are operated. On the standard-gauge lines about 60 cars additional are operated, making a total of nearly 400 cars in use,

equipped with both General Electric and Westinghouse motors.

Electricity for operating the railway and lighting system is generated in four stations with an aggregate output of 10,000 kw. The smallest of these is the Milo station just outside of the city limits which had a capacity of 800 kw. The Milo station has within the past month been converted into a sub-station, and a National 500-kw motor-generator set installed by the National Brake & Electric Company, of Milwaukee, Wis., to supply current to the system in this district. This set is of the three-bearing

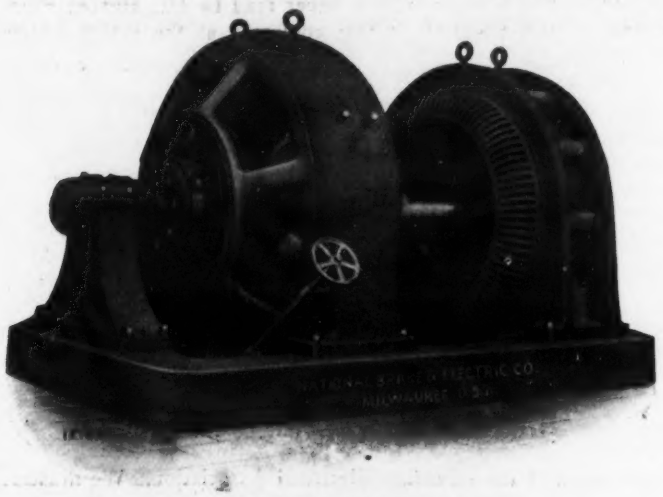


FIG. 1.—NATIONAL MOTOR-GENERATOR.

type and consists of a 750-hp, three-phase, 60-cycle, 600-r.p.m. synchronous motor, receiving current at 4,100 volts and driving a 500-kw, direct-current generator, which generates at 575 volts and delivers 870 amp. The construction of these machines provides for a liberal rating and low temperature rises and at the same time gives a compact set of very rugged appearance and graceful lines.

The Columbus Railway & Light Company has also recently in-

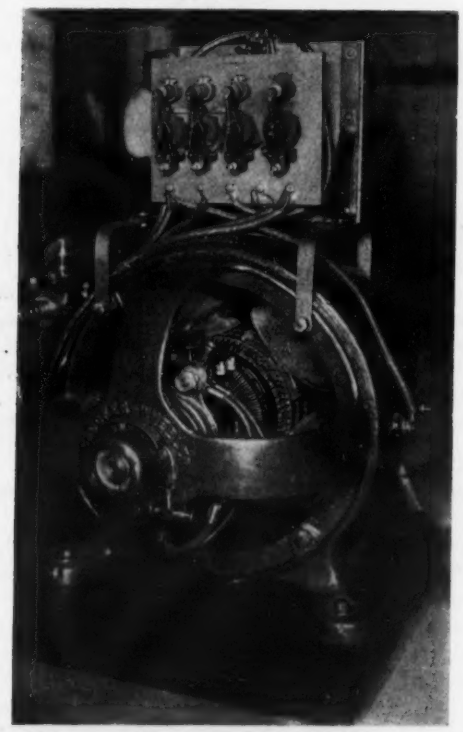


FIG. 1.—MOTOR-STARTER ATTACHED TO MOTOR.

stalled a National induction motor-generator set in a new sub-station at the corner of High and Town Streets. This set is used for bridging in on the underground Edison lighting circuit. This set comprises a 75-hp motor wound for three-phase, 60-cycle, 4,100-volt current and driving a 250-kw, 250-volt, direct-current generator at a speed of 720 r.p.m. The present connected lighting load of the company is about 150,000 16-cp lamps. In the business section of the city the lighting system is underground.

Automatic Motor Starters.

The accompanying illustrations show a very compact and easily operated automatic motor starter which possesses neither rubbing contacts, suction air pots, cams, gears nor other auxil-

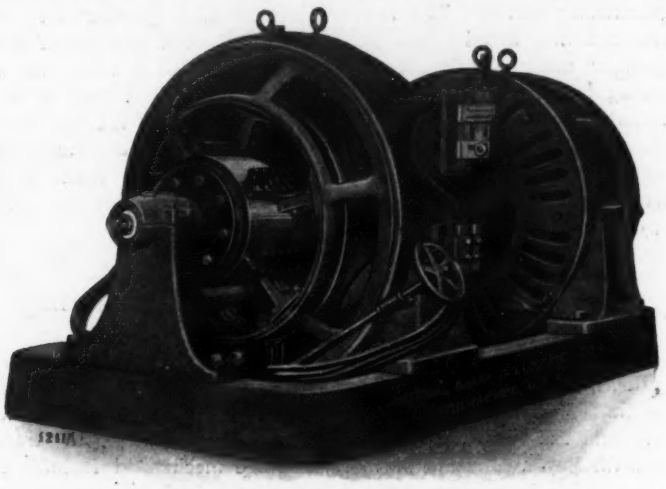


FIG. 2.—NATIONAL MOTOR-GENERATOR.

iary apparatus. The contacts are made through carbon blocks by adjustable rocker arms, and only such movements as have been predetermined take place. One set of contacts cannot operate without the supplemental action on the part of every other contact on the board. The resistance is of special construction, the flat resistance strips being laid upon an insulating base in such a manner as to insure proper ventilation. Referring to Fig. 1, the starter operates as follows: When the remote control switch is closed, the magnet on the first contact on the right attracts its rocking arm. This cuts in the resistance and starts the motor. Then one by one the rocking arms to the left are attracted, the action beginning with the one on the extreme left of the board. As each arm makes contact a piece attached to the side cuts out that section bringing the next arm into play and so on until all the resistance is cut out. By means of small set screws on the bottom of each rocker arm the distance between the magnet and the arm may be increased or diminished and thus the rapidity with which the resistance is cut out may be retarded or quickened. The only

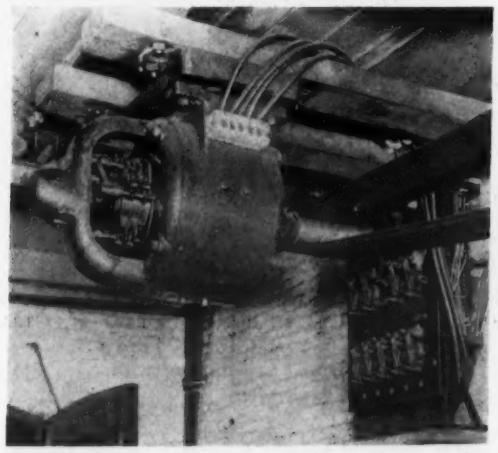


FIG. 2.—ELEVATOR CONTROLLER FASTENED TO WALL.

wear comes on the first contact piece on the right and the repairing of this is very simple, the worn piece being easily removed and a new part substituted at trifling cost. Mr. G. A. Annable is the general sales manager for the apparatus, which is built by the New York Electric Controller Company, 21 New Chambers Street, New York.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The Fall season is now fairly well advanced in the matter of business, although the weather has continued generally milder than usual, with irregularities in the way of heavy storms, which in the South have been followed up by an advance of 1½c. a pound in cotton. The crops have been somewhat slow in harvesting, owing to the wet weather, and the marketing of grain has been light, but it is seen that the corn crop will exceed that of any previous year and the prosperous condition of the farmers is generally above question and beyond precedent. All classes of manufacturing are active, and the jobbing and retail trade is making new records, although the railroads find themselves congested with freight and there is much complaint as to the slow delivery of goods required by the market. Pig iron has advanced again and prices are higher than for the last three or four years, No. 2 foundry iron for prompt shipment fetching as high as $22 valley, while Southern product is quoted at $17.50 at Birmingham. But the most remarkable advance is that seen in copper, which has climbed to within hailing distance of 21c. and is firm above 20c. It seems doubtful that quotations can go very much higher as they must sooner or later bring about their own check on consumption, but apparently no relief is in sight for the consumer just at the present minute. Bank clearings for the week ended October 4 were 19 per cent. over the preceding week and 12 per cent. above the corresponding week of last year. Business failures numbered only 136, against 165 in the preceding week and 189 in the same week of 1905, besides being 34 less than in the corresponding week of 1902. Such figures are an encouraging symptom of soundness in business and absence of over trading, and the returns for nine months show that the failures in that period were the smallest in a great many years, as well as exhibiting a decrease of 8.8 per cent. in number as compared with last year and an increase of only 2.2 per cent. in liabilities, owing to two bank or trust company failures which stand somewhat unique as examples of financial dishonesty. Electrical trade is everywhere reported brisk. The New York Telephone Company has made a record in telephone installations, and central station companies throughout the country are making extensions and connections at an unprecedented rate. The earnings of all the trolley systems also show steady gains. The international copper markets, as already noted, reflect unprecedented demands for lake, electrolytic and costing. The pressure from European wire drawers for American electrolytic is strong for February and March, beyond which time the larger producers will not make contracts under existing conditions. For November and December little metal is available, as the larger producers are sold out to the end of the year. For January and February electrolytic is 20½ to 20¾c.; lake, 20¾ to 21c. Casting copper, deliveries within sixty days, is at 20¼ to 20½c. The quotations for other metals were: Pig lead, 5.90 to 6c.; antimony, 23 to 24c.; nickel, 40 to 47c.; aluminum, 36c.; zinc, 7.75c.

ALLIS-CHALMERS ENGINE ORDERS.—The steam engine department of the Allis-Chalmers Company reports the following recent orders and sales: San Marcos Light & Power Company, San Marcos, Texas, Reynolds Reliance Corliss engine. H. C. F. Koch & Co., New York, Reynolds Reliance Corliss engine; 200-kw Allis-Chalmers generator. City of Jackson, Jackson, Ga., Reynolds Reliance Corliss engine. U. S. Envelope Company, Springfield, Mass., Reynolds Reliance Corliss engine. Consolidation Coal Company, Buxton, Iowa, Reynolds heavy-duty Corliss engine, 16 in. by 42 in.; Reynolds heavy-duty engine, 300 kw. belted to direct-current generator. Indianapolis & Louisville Traction Company, Pittsburg, Pa., two heavy-duty Reynolds Corliss engines. Ellsworth Coal Company, Pittsburg, Pa., Reynolds Reliance Corliss engine; 400-kw. direct-current Allis-Chalmers generator. Atlantic Portland Cement Company, Nazareth, Pa., Reynolds heavy-duty cross-compound Corliss engines. 2-22 in. and 44 in. by 48 in.; Reynolds heavy-duty cross-compound Corliss engines, 3-20 in. and 40 in. by 48 in.; Reynolds heavy-duty cross-compound Corliss engine, 16 in. and 32 in. by 42 in.; Reynolds heavy-duty cross-compound Corliss engine, 20 in. and 40 in. by 42 in.; 500-kw Allis-Chalmers generator; 400-hp Allis-Chalmers induction motor; four 75-hp Allis-Chalmers induction motors; two 50-kw O. F. S. C. transformers, switchboard. Mauch Chunk Heat, Power & Light Company, Mauch Chunk, Pa., Reynolds Reliance Corliss engine. Sioux Falls Electric Light & Power Company, Sioux Falls, S. D.; Reynolds Reliance Corliss engine. The gas engine department reports the following: American Steel & Wire Company, Cleveland, Ohio, 1,500-hp horizontal twin tandem Allis-Chalmers gas engine; 1,000-kw alternating-current generator. Comstock-Haigh-Walker Company, for Milwaukee Northern Electric Company, horizontal twin tandem Allis-Chalmers gas engines; three 1,000-kw Allis-Chalmers alternating-current generators; two 50-kw vertical gas engine exciter sets; seven 500-kw transformers; thirty-six 100-kw transformers; two 125-kw transformers; fourteen 300-kw rotary converters; four 400-kw rotary converters, two 45-kilovolt-amp. O. F. S. C. reactive coils; main station switchboard; eight sub-station switchboards.

A FAMINE IN POLES appears to be threatening as a result of the activity in the electrical field. Mr. A. D. Morse, construction manager of the Cuyahoga Telephone Company, of Cleveland, Ohio, says: "Prices have been raised 50 per cent in the past five years, and are steadily advancing. We like to get cedar poles because they are lighter and more durable, but we are glad to get chestnut or any other kind of pole nowadays. The Michigan field seems to have been exhausted, and we now get poles from the North, South and West. It does not pay yet to use iron poles, but the day is sure to come when it will be necessary to do so. Every year sees more telephone and telegraph wires going underground. In most cities they are placed there because of convenience. There is a good deal more expense connected with conduit construction, but of course there is not the cost of maintenance."

THE WESTINGHOUSE ELECTRIC & MFG. CO. is being awarded an increased number of government contracts. A recent contract just closed calls for a large amount of electrical power generating apparatus to be installed in the Navy Yard at Norfolk, Va. The contract totals $91,125 and consists of the following apparatus: Two 1,000-kw, three-phase, 2,200-volt, 60-cycle, 1,800 r.p.m. steam-turbine generating units; one 500-kw, three-phase, 2,200-volt, 60-cycle, 3,600 r.p.m. steam-turbine generating units; two 50-kw steam-driven exciter units; five 50-kw motor-generator sets. The motors composing these sets are designed for three-phase, 2,200-volts, 7,200 alternations, 1,120 r.p.m. The direct-current generators are wound for from 95 to 140 volts. An interesting part of the equipment is the switchboard, which will have 42 panels. A large amount of auxiliary apparatus is included in the contract.

NEW KOPPEL FACTORY.—Dodge & Day, Philadelphia, are making good progress with the American plant of the Arthur Koppel Company, which is located near Pittsburg. The steel is now being erected, and orders have been placed for the boilers, engines, generators and power-house equipment. Specifications are out now for five traveling cranes and for the heating equipment. The doors and windows and about twenty carloads of lumber will be ordered at once. The work is being pushed as rapidly as possible, and the shops will be in operation before the close of the winter.

GROWTH OF NORTHERN ELECTRIC.—The Northern Electric Manufacturing Company, of Madison, Wis., is enlarging its works. The addition will be 115 by 250 ft. and with equipment will represent an outlay of about $100,000. It will be the principal machine shop of the plant and the present machine shop will be given over to specialty work. Contracts are now being let for the building mostly to local firms, and it is planned to have it enclosed and roofed by the holidays. When completed some 200 more men will be needed.

INTERSTATE RAILWAYS.—Negotiations have been closed between the Interstate Railways Company, which owns a number of electric lines in New Jersey and Pennsylvania, and the Philadelphia, Bristol & Trenton Street Railway Company, whereby the latter becomes a part of the Interstate system. Control of the Philadelphia, Bristol & Trenton was held in Baltimore. The price paid was not made public.

EQUIPPING A SAW MILL.—The Allis-Chalmers Company has received the following orders for saw mill equipments: American Cigar Box Lumber Company, Johnson City, Tenn., 10-kw generator, 25-kw generator, two 10-hp motors, 7½-hp motor, 3-hp motor and switchboard.

TRACTION PLANT FOR TOLEDO.—Up to the present time the Toledo, Port Clinton & Lake-Side Railway, which is one of the network of Ohio and Indiana lines now furnished with the new Allis-Chalmers railway equipment, has operated cars from the Toledo city limits to Genoa—10 miles—over the tracks of the Lake Shore Electric Railway, and has had its own traffic arrangement with the city company for entrance to Toledo and the use of the terminal station. As the Lake Shore is a single-track line and has a heavy traffic of its own, the Port Clinton Company saw that its summer traffic was handicapped, and arranged for an independent entrance to Toledo, confident that it would prove a profitable addition to its holdings. Accordingly a private right-of-way was secured from the present junction north to the village of Curtice, thence to Booth and into Toledo by way of a city line, which gives a shorter route to the center of the city. The new section, the construction of which was begun about a year ago, is now practically ready for operation. A sub-station located near the limits of Toledo will furnish power for operating cars over the new section of track. A three-phase, 20,000-volt transmission line is led from the power house at Port Clinton to the rotary sub-station. There are sub-stations at Genoa, Oak Harbor, Port Clinton, Marblehead and the new one installed near Toledo, making an average distance of 13 miles between stations. The main equipment for the entire road was furnished by the Allis-Chalmers Company, of Milwaukee, including the power house and sub-station apparatus, car motors, controllers, etc. In the main station two horizontal cross-compound condensing Allis-Chalmers engines are direct connected to Allis-Chalmers revolving field, engine type A. C. generators of 800-kw each, delivering current at 275 volts, three-phase, 25 cycles. Current from each large generator is led via six rubber insulated cables through the switchboard to three 500-kw, 375-20,000-volt, oil-filled, water-cooled Allis-Chalmers transformers placed back of the switchboard. The sub-stations are each equipped with a 400-kw Allis-Chalmers rotary converter and suitable step-down transformer and boards.

THE RAIL JOINT COMPANY.—The enlargement of the steam rolling mill of the Rail Joint Company, at the city of Troy, N. Y., known as the Albany Iron & Steel Works, has been completed. The rolling mill building is 400 ft. long, independent of the machine shops and other buildings. The electric conveying crane, over 600 ft. long, carries steel billets from the yard, constantly feeding the furnaces so as to supply two 21-in. trains that are in operation day and night rolling rail joints for "T" and girder rail sections, for steam and electric railways. The value of the company's products is shown by the fact that over 25,000 miles of track are equipped with their base-supported rail joints, and the extent of their use is the best evidence of their excellence. The Troy mill has a capacity to roll over 125 different sections of rail joints, and there are over 350 men employed in its operation. A railroad siding, or switch, of the N. Y. C. & H. R. R. R. Co. runs around the property, bringing raw material, coal, and steel billets into the yard, and taking out the finished products. Special attention is being given to the production and perfection of the girder and insulating rail joints of various base-supported types. While the Rail Joint Company own the works at Troy, N. Y., they have nine other distributing points where their patented machinery and devices are used to produce their rail joints under contract with other mills for the convenience of their customers, making deliveries from Buffalo and New York City, N. Y.; Newark, N. J.; New Castle, Del.; Steelton and Pittsburg, Pa.; Chicago and Joliet, Ill., and Milwaukee, Wis. The company maintains fourteen branch selling agencies. Their general offices are at 29 West 34th Street, New York City.

PARSONS TURBO BLOWERS.—In a paper recently presented at a meeting of the British Association for the Advancement of Science by Gerald Stoney, on the subject of "Recent Advances in Steam Turbines—Land and Marine," the author described the development of the steam turbine for driving rotary air compressors of the turbine type, which are now being used largely for blowing blast furnaces. The outfits described are generally for about 20,000 cubic feet of free air per minute, and a pressure of 10 to 15 pounds per square inch. A slightly different type is made for about 30,000 cubic feet per minute, at about one pound per square inch pressure. These blowing equipments are being used in several large iron works for dealing with the waste gases from furnaces and for driving these gases through the recovering plant, etc., an important feature being that they do not clog with tar and other matters. The American rights for the manufacture of Parsons turbine blowers, as well as Parsons land and marine turbines, have been secured, it is stated, by the Allis-Chalmers Company, of Milwaukee, and through an arrangement made with the English builders, the American company will have the benefit of the experience and data of the European experts.

LARGE TELEPHONE ORDER.—Frank B. Cook, of Chicago, believes that he has smashed all records for orders with his No. 10 protector, furnished to the Kinloch Telephone Company, St. Louis, for their new exchange. The order was for 16,000 pairs, the largest single protector board ever installed. The protector was designed especially for the Kinloch Telephone Company and had to be designed and manufactured in a hurry. Under such unfavorable circumstances, a manufacturer's cup of woe is generally full and running over when it comes time to install the apparatus. As a general rule, troubles without number spring up in the most unexpected and unlooked-for places. Contrary to all precedent and rule, Cook's No. 10 protector developed none of the customary eccentricities. The protectors were installed by Stromberg-Carlson Telephone Manufacturing Co., and when the cut-over was made, only nineteen cases of trouble were found in the entire 16,000 pairs. Only two of these were spring troubles, due to slight faults in the assembling.

ELECTRIC PROPELLER FANS.—The B. F. Sturtevant Co., of Boston, Mass., report very large recent sales of their electric propeller fans, consisting of special type of propeller wheel and the entirely enclosed, direct-connected electric motor forming a part of the general construction, to the following: Grand Central Station, New York City; Providence Telephone Company, Providence, R. I.; H. A. Johnson & Co., Boston, Mass.; H. E. Carrington, New York City; R. H. Stearns & Co., Boston, Mass.; four for Charles N. Knox, Hartford, Conn.; Cudahy Packing Company, Philadelphia, Pa.; Hotel Touraine, Boston, Mass.; eight for Armour Packing Company, Kansas City, Mo.; Ralph J. F. Gerstle Company, New York City; Parker House, Boston, Mass.; Union College, Schenectady, N. Y.; three for Shawmut Bank, Boston, Mass.; American Steel & Wire Company, Cleveland, Ohio, and William Bradley, Homestead, N. J.

THE ELECTRIC CONTROLLER & SUPPLY CO., Cleveland, O., announces the opening of a Chicago office in the Merchants Loan and Trust Building, 135 Adams St., Chicago, Ill., with Mr. W. H. Connelly in charge. Mr. Connelly was connected with the electrical department of the Homestead Works of the Carnegie Steel Co. for five years, and resigned his position there to become electrical engineer of the Ensley plant of the Tennessee Coal, Iron & R. R. Co. at Birmingham, Ala., which position he held for three years, and resigned to enter central station work at Birmingham, Ala., and at Houston, Tex., where he organized and had charge of the sales department. Mr. Connelly enters upon his new duties fully equipped to take care of the interests of the company in the Chicago district.

CROSBY, CRAFT & CO., Cleveland, Ohio, have removed their offices from the Citizens' Building to 723 Williamson Building. Crosby, Craft & Co. are the agents in northern Ohio of the Switchboard Equipment Company, the Whitney Electrical Instrument Company, the Northwestern Manufacturing Company, the Fort Wayne Electric Works and the General Storage Battery Company. They report that they have closed a contract with the Brown Hoisting Machinery Company, Cleveland, for 69 large capacity circuit-breakers of the Switchboard Equipment Company's manufacture. The Brown Hoisting Machinery Company will use these in connection with an installation they are furnishing for the Carnegie Steel Company.

DIRECT-CONNECTED ELECTRIC FANS.—The increasing use of the direct-connected electric fans of various types and sizes is manifest in the increasing orders received by the B. F. Sturtevant Company, of Boston, Mass., among which the following have been reported: Solvay Process Company, Syracuse, N. Y.; Julius Kayser & Co., Brooklyn, N. Y.; Geerin Bros. Co., Cincinnati, Ohio; S. Pearson & Son, Inc., Long Island City, N. Y.; Empire Machine Company, Pittsburg, Pa.; T. Eaton & Co., Toronto, Ont.; United Shoe Machinery Company, Boston, Mass., and Tuttle & Bailey Manufacturing Company, Brooklyn, N. Y.

STURTEVANT GENERATING SETS.—The B. F. Sturtevant Co., of Boston, Mass., report increasing sales of generating sets with enclosed forced lubrication engines. Among recent orders are those from Palmer Shipbuilding Company, Noank, Conn.; James Clark Co., Baltimore, Md.; Raeford Power & Manufacturing Company, Raeford, N. C.; Kiernan-Hughes Co., Jersey City, N. J.; Thomas G. Plant Co., Jamaica Plain, Mass.; Selden Cypress Door Co., Palatka, Fla., and Millard & McLean, New York City.

ELECTRICITY FOR BAHIA.—The government of the State of Bahia has granted to Guinle & Co., whose headquarters are in Rio de Janeiro, a concession to make use of the Falls of Jaguaribe, in the district of Nazareth, for an electric power installation. The development of the concession will revolutionize light, power and transportation methods in Bahia.

THE MEXICAN LIGHT & POWER COMPANY, of Mexico City, intend to install a machine shop and foundry at its Necaxa power house and would be pleased to receive catalogues for a complete equipment, including small shop tools and steel. Address Edward W. Lawton, master mechanic Mexican Light & Power Company, Necaxa, Puebla, Mexico.

Financial Intelligence.

THE WEEK IN WALL STREET.—The course of the stock market during last week and up to the present moment of writing has been one of fluctuations, but of sustained strength and marked activity, the total sales of stock for the week being a few short of 6,000,000, indicating a steady run of business every day. The greatest activity was in Reading, of which 1,503,560 shares were sold, but owing to the reports as to closing the ore deal, no fewer than 867,000 shares of U. S. Steel Common also changed hands. During the week a very noticeable activity developed itself in General Electric, which ran up from 165 to 175½ and which closed on Monday of this week at 183¾. This gain and activity are explained on the ground that there will be an additional issue of stock shortly to provide new capital, the company having available in its treasury over $5,000,000 unissued. It is, however, suggested that the authorized total may be increased giving valuable rights to the present stockholders. The company is paying 8 per cent. dividends and has been earning far in excess of that rate. During last week 13,400 shares were dealt in. There was very little activity in either Western Union or American Telephone and Telegraph during the week, and the dealings in tractions were also comparatively light. There was not much doing in Westinghouse Electric, but that stock is strong and appears to be moving in sympathy with the General Electric, and the same may be said of Allis-Chalmers. The closing quotations of October 9 are given below:

NEW YORK

	Oct. 2	Oct. 9		Oct. 2	Oct. 9
Allis-Chalmers Co.	17¼	17⅝	General Electric	166	181
Allis-Chalmers Co; pfd.	42	46¼	Hudson River Tel	...	...
American Dist. Tel	25	25	Interborough Rap. Tran	...	...
American Locomotive	73¾	76¾	Mackay Cos.	72	73
American Locomotive pfd.	111	112	Mackay Cos pfd.	71	70
American Tel. & Cable	90	90	Marconi Tel	...	...
American Tel & Tel.	139½	...	Metropolitan St. Ry	...	...
Brooklyn Rapid Transit	77⅜	78⅛	N. Y. & N. J. Tel.	...	...
Electric Boat	15	15	Western Union Tel.	...	88⅛
Electric Boat pfd.	60	60	Westinghouse com	145	158
Electric Vehicle	11	11	Westinghouse pfd	...	...
Electric Vehicle pfd	18	18			

BOSTON

	Oct. 2	Oct. 9		Oct. 2	Oct. 9
American Tel. & Tel.	139	136¼	Mass. Elec. Ry. pfd	70⅛	70
Cumberland Telephone	118	...	Mexican Telephone	4⅛	7
Edison Elec. Illum.	235¼	235	New England Telephone	130	...
General Electric	166¼	184¼	Western Tel. & Tel.	...	10
Mass. Elec. Ry.	19	18	Western Tel. & Tel. pfd	87	85

PHILADELPHIA

	Oct. 2	Oct. 9		Oct. 2	Oct. 9
American Railways	51	51⅛	Phila. Electric	8¼	8¼
Elec. Co. of America	11¼	11⅜	Phila. Rapid Trans	28¾	28¼
Elec. Storage Battery	70	73	Phila. Traction	97⅞	97⅞
Elec. Storage Battery pfd.	...	...			

CHICAGO

	Oct. 2	Oct. 9		Oct. 2	Oct. 9
Chicago City Ry.	140	140	National Carbon	85	85
Chicago Edison	140	...	National Carbon pfd.	115	115
Chicago Subway	...	53	Union Traction	...	...
Chicago Tel. Co.	118½	...	Union Traction pfd.	...	...
Metropolitan Elev com.	28	28			

THE TWIN-STATE CONSOLIDATION.—A special dispatch from Dover, N. H., of October 3, gives the subjoined further information as to the recent changes in ownership there: The purchase of the Dover Electric Light & Power Company by the Twin-State Gas & Electric Company, which was recorded here yesterday, was a step in the extension into New England territory of the control of the National Light, Heat & Power Company, of New York, which already controls many plants in other parts of the country. The Dover company, it is learned, is one of several, which either have been acquired or will be taken over shortly. These companies include the electric light interests at Dover, Rochester, Somersworth, Salmons Falls and Hinsdale, N. H.; Berwick, North Berwick, South Berwick and Lebanon, Me., and the electric light and street railroad plants at Brattleboro, Vt. The electric lighting company at Dover has controlled the street railway interests in Dover, Rochester and Somersworth and also furnishes power for the Portsmouth, Kittery & York Railroad, connecting several Maine and New Hampshire points. It is understood that the plans for extending the company's interests in New England also include the acquisition of the control of some 100 miles of electric street railway in Maine, some of which is yet to be built, although franchises and locations have been granted. The Twin-State Company, which was incorporated at Hartford, Conn., for the purpose of consummating these transactions, is capitalized at $1,750,000, the stock shares being divided into $1,500,000 common and $250,000 5 per cent preferred shares. Harold G. Villard, of New York, is president, and the directors are F. L. Eldridge, vice-president of the Knickerbocker Trust Company; A. H. Bickmore, of Bickmore & Co., bankers; H. G. Villard, attorney; William H. Wherry, attorney; C. C. Cuyler, of Cuyler, Morgan & Co., bankers, and Gustave Ulbrecht, of J. P. Morgan & Co., all of New York. It is the plan of the company to issue $1,500,000 in 4½ per cent gold bonds, $500,000 to be reserved in the treasury for future improvements to the property, another $500,000 to be set aside to buy existing bonds outstanding, and the remaining $500,000 to be underwritten for cash. It is estimated that the companies taken over by the Twin-State Corporation have gross annual earnings of about $210,000, with operating expenses of $119,000. The National Light & Power Company, controlling the Twin-State Gas & Electric Company, is a $5,000,000 corporation.

LIGHTING IN NEW YORK CITY.—Now that prospects of a municipal plant have quite faded away, possible competition with the New York Edison Company has cropped up in another shape, and the names of Messrs. Joseph H. Hoadley, John C. Sheehan and Tom L. Johnson are associated with the project. Mr. Sheehan states that the first use to be made of the franchise he and his associates secured with the Manhattan Transit Company and the Long Acre Light & Power Company would be the construction of a plant to furnish electric light and power in opposition to the Consolidated Gas Company. A syndicate, he said, had undertaken to underwrite $5,000,000 bonds, and his company had made arrangements for all the money it would need. "I and my associates," said Mr. Sheehan, in a typewritten statement, "have been giving considerable attention to a comparison of the electric service in this, the most progressive city in the world, with the other cities and towns of our country, and we have been surprised to find how inadequate the service is. Whereas there should be a kilowatt of power for every ten inhabitants, this city has only a little more than one-third of this. There are whole districts that are not only not supplied with electric power and light, but seem to have no immediate prospect of getting it. It is doubtful if the existing company can take care of the natural increase of the demands of their present patrons, to say nothing of supplying the unlighted field." Mr. Sheehan admitted that the franchise of the Long Acre Company covered only the territory between Forty-second and Fifty-ninth Streets, East and North Rivers. But in 1886 there was granted by the Board of Aldermen a franchise to supply electric light and power in all Manhattan, and this franchise, granted originally to the American Electrical Manufacturing Company, has lately come into Mr. Sheehan's possession, and around this nucleus other projects for the larger field are grouped.

ADVANCE IN GENERAL ELECTRIC.—A notable rise last week in the quotations of General Electric stock was accompanied by rumors that the company had in contemplation an additional issue of stock to be offered to present stockholders on terms which would make the subscription rights valuable. That there is any immediate intention of increasing the amount of the General Electric Company's stock could not be confirmed officially. The report, however, was credited that before long there will be given to stockholders the chance to subscribe to new stock on favorable terms. Some of the rumors brought in the name of the American Locomotive Company. The present authorized capital of the General Electric Company is $60,000,000, of which a little over $52,000,000 is outstanding. During the seven months of the General Electric Company's fiscal year now ended, the volume of new business has been unprecedented and indicates a total for the fiscal year of between $55,000,000 and $60,000,000. At the close of the last fiscal year, when orders booked for the first time touched the $50,000,000 point, the officials of the company felt that the high-water mark had probably been recorded for a year or two.

DIVIDENDS.—The Fall River (Mass.) Electric Light Company has declared a quarterly dividend of 2 per cent. Directors of the San Diego Consolidated Gas & Electric Company have declared a dividend of 1¼ per cent on the preferred stock of the company, payable October 12.

GENERAL NEWS.

Construction News.

PINE BLUFF, ARK.—The Citizens' Light & Transit Company will soon commence on the extension of its line from Sixth street and Main street, east on Sixth avenue to the city limits.

GRAVETTE, ARK.—R. J. Claflin, vice-president of the Electric Light Company, of Carthage, Mo., it is reported, is interested in the project to establish a lighting plant in Gravette. Mr. Claflin, it is stated, proposes supplying and installing the equipment which will be mantained by a home company, probably the Gravette Milling Company, of which T. E. Leonard is a member.

UPLAND, CAL.—The telephone franchise, recently advertised for sale by the city trustees, has been awarded to C. T. McClulloch, of Upland, for $750.

SANTA CRUZ, CAL.—The Coast Counties Power Company has purchased the plant of the Big Creek Power Company. This transaction gives the purchasing company control of all electric plants in Santa Cruz County. The company now has a capacity of 2,700 hp, and is planning to increase this by 1,000 hp next spring. A steam auxiliary will be established, to be used during the low-water periods.

DENVER, COLO.—Owing to the rapid growth of its business at the York Exchange, the Colorado Telephone Company will install a new switchboard in the York exchange and will also erect a new building adjoining the present structure to cost $18,000.

DANIELSONVILLE, CONN.—The Danielson Cotton Company is wiring its mill for electric lamps, the electricity for lighting the mills will be generated by a plant on the premises.

NEW LONDON, CONN.—The Consolidated Railway Company is arranging to enlarge its Thamesville power house and increase the capacity of the plant about 1,000 hp. Two new boilers and a new generator will be installed. H. Bigelow is superintendent.

STAMFORD, CONN.—It is said that the New York & Stamford Railway Company is contemplating the extension of its line to New Rochelle, and may decide to build to Mt. Vernon. The company has already acquired the right of way between Larchmont and New Rochelle over private property.

WALLINGFORD, CONN.—At a special town meeting held recently it was voted to appropriate $8,500 for extending and improving the municipal electric lighting plant, thus making the total amount available for improvements $14,000. The new extensions to the plant will consist of a water wheel, generators and other appliances, in addition to those voted for last April.

HARTFORD, CONN.—The Hartford Electric Light Company has made a reduction in the price of electricity for lighting purposes. The reduction benefits the small consumer. To those using up to 50 kw per hour the price has been reduced from 13 to 11 cents per kw-hour, from 50 to 100 kw per hour the price has been reduced from 12 to 11 cents per kw-hour. The usual 5 per cent discount and the $1 monthly minimum charge continue.

HOCKANUM, CONN.—Lewis W. Ripley, of the Glastonbury Power Company, on Oct. 2 presented a draft of the proposed agreement between the fire district and the Glastonbury Power Company. The company asks for the right to erect, equip and maintain poles for the transmission of electricity for lighting and power in Hockanum for a term of ten years, after which time the district may purchase the equipment at a satisfactory price if it cares to do so.

BRIDGEPORT, CONN.—The Connecticut Railway & Lighting Company, of Bridgeport, Conn., a subsidiary company of the United Gas Improvement Company, of Philadelphia, has placed an order for a 26 x 54 x 54 inch Reynolds heavy duty, cross compound engine, direct connected to a 1,200-kw direct-current generator. The engine will be run at a speed of 90 r.p.m. and a steam pressure of 150 lbs. The unit will be used for general power purposes. The engine will be built at the West Allis, Milwaukee, works of the Allis-Chalmers Company.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts until Oct. 23 to furnish at the navy yards, etc., Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Annapolis, Md.; Washington, D. C.; Norfolk, Va., and Charleston, S. C., a quantity of naval supplies as follows: Schedule 193—incandescent lamps, wire, conduit and fittings, electrical supplies, etc. Schedule 196—electrical supplies, electric grinders, copper wire, rod and sheet copper, etc. Schedule 197—circuit breaker, sheet copper, brass and copper rod, steel plates, etc. Schedule 198—electrical wire and supplies, jacks, etc. Application for proposals should designate the schedule desired by number. H. T. B. Harris, Paymaster General, U. S. N.

JACKSONVILLE, FLA.—Negotiations which have been pending for several months were closed Oct. 4 whereby the Jacksonville Electric Company agrees to transfer to the city of Jacksonville its franchise for electric lighting and will retire from further competition with the city plant. The company is to operate the plant until Jan. 18, 1911, and is to pay over to the city 20 per cent of the gross receipts, retaining 80 per cent as its share for operating the plant. The city is to purchase on or after Jan. 18, 1911, at an appraised valuation the company's overhead system used for the distribution of electricity furnished to consumers. With this agreement entered into by the electric company and the board of bond trustees, the way will be cleared for the company to push its applications for franchises for the extension of its present street railway lines and the construction of new lines. The present charter of the city prohibits the City Council from granting any franchises to any company that is in competition with the city in furnishing electricity for lighting and power.

DEWEY, IDA.—The Trade Dollar Consolidated Mining Company will expend about $100,000 in enlarging its plant at Swan Falls. Four turbines direct connected to generators will be installed, increasing the capacity of the plant about 2,000 hp. An addition will be built to the power plant 130 feet long and 30 feet wide, making the total length of the power house 265 feet long. Contracts for the wheels and generators have been awarded. Work is to be pushed on the extension and it is hoped to have it completed by February 1. Frederic Irwin is manager of the company.

MILO, ILL.—The Empire Telephone Company has increased its capital stock from $20,000 to $35,000.

MARSEILLES, ILL.—The Marseilles Telephone Company has increased its capital stock from $4,000 to $12,000.

CHICAGO, ILL.—Bids will be received until Oct. 17 by William Carroll, city electrician, for extending the present steam and exhaust piping system of the N. H. May electric light station, Fullerton Avenue.

CHICAGO, ILL.—The Western Electric Company, of Chicago, has secured the contract for 300 30-foot tubular steel poles and 300 pole tops to slip inside the poles, and the Illinois Malleable Iron Company, 32 Monroe Street, secured the contract for 300 cast iron ornamental bases. Wm. Carroll is City Electrician.

CHICAGO, ILL.—Plans are being made by the Chicago, Desplaines & Fox River Railroad Company to begin work on the proposed line from Chicago to McHenry, Ill., and ultimately to Lake Geneva, Wis. The contracts for steel and fittings have been let, but no overhead or equipment contracts have been awarded. H. L. Emerson, Washington and LaSalle Streets, Chicago, is engineer for the company.

CHICAGO, ILL.—The Cleveland Construction Company, of Cleveland, has secured the contract for the electrical and mechanical engineering of the Chicago, Lake Shore & South Bend Railway. This line is under construction between Chicago and South Bend. The road will cost in the neighborhood of $3,000,000. It is being promoted by a Cleveland syndicate headed by J. B. Hanna of that city.

PETERSBURG, ILL.—Surveys have been made and the right of way about secured for the proposed electric railway of the Springfield, Beardstown & Quincy Interurban Railway Company. The line will pass through Salisbury, Loyd, Petersburg, Newmansville, Chandlerville and Beardstown, starting from Springfield, and will touch old Salem and Chautauqua. The officers are H. H. Colby, president; C. W. Houghton, vice-president; P. E. Bone, secretary and treasurer; Charles W. Brown, of Jacksonville, is engineer.

CARLYLE, ILL.—The telephone system in Clinton County is now being operated by the Citizens' Telephone & Telegraph Company. The new company bought the system from George Johnpeter, of Posey, for $11,000 and it will continue to be operated in connection with the Central Union long distance, although this county will be the exclusive territory of the home company for local business. The system will be extended to Shattuc, Boulder, St. Rose, Bartelso, Jamestown and other parts of the county. Another home company known as the People's Home Company has applied to the County Board for permission to build a system in the county.

WEST LEBANON, IND.—Isaac Hall, town clerk, writes that it is proposed to construct an electric light plant, at a cost of $6,000.

LAFAYETTE, IND.—The Lafayette Telephone Company has increased its capital $45,000, to be used in installing new equipment and making extensions and improvements.

TERRE HAUTE, IND.—Application has been made by the White River Power Company for a franchise to furnish electricity for light, heat and power for the city of Terre Haute.

RICHMOND, IND.—An ordinance is being considered by the Council authorizing the issue of $28,000 in bonds for the purpose of improving and erecting additions to the municipal lighting plant.

EVANSVILLE, IND.—The White River Power Company, which proposes to build a dam in White River near Decker, has petitioned the City Council for a franchise to furnish Evansville with arc lamps at $52 a year, a saving of $17 over the present price.

INDIANAPOLIS, IND.—The Indianapolis & Eastern Railway Company will soon make extensive additions and improvements to its power house at Spring Lake. A 1500-hp turbo-generator set and several boilers will be installed.

GREENCASTLE, IND.—At a recent meeting of the trustees of De Pauw University, held at the office of the Union Trust Company, at

Indianapolis, authority was given the executive committee to proceed at once to install an electric light plant.

LAFAYETTE, IND.—The County Commissioners have granted a franchise to the Lafayette & Hoopeston Interurban Railway for the right of way through Tippecanoe County for a period of 50 years. The company's headquarters are at Otterbeim, Ind.

EVANSVILLE, IND.—A new syndicate to be known as the United States Railway Company has secured control and merged the Evansville & Mt. Vernon, Evansville & Newburg, Evansville & Booneville and the Evansville & Eastern traction lines. The syndicate will have a capital stock of $3,000,000 and is composed of Cincinnati, Pittsburg and Indiana capitalists. The company will build a terminal, similar to the one in Indianapolis, several extensions and new lines.

SOUTH BEND, MICH.—The Kalamazoo, Elkhart & South Bend Traction Railroad Company has been chartered in Indiana and Michigan to construct an electric interurban railroad. Surveys have been made for the line; 30 to 50-year franchises have been secured in all cities and towns. The company has contracted with the St. Joseph & Elkhart Power Company, which has a power plant at Hen Island, on the St. Joseph River, near Mishawka, for electricity to operate the line when completed.

TULSA, I. T.—The Tulsa Street Railway Company has completed all preliminary arrangements, and contracts will soon be let, after which the work will soon commence.

VINTON, IA.—The Vinton & Benton County Telephone Company will rebuild and improve its telephone system.

GOWRIE, IA.—The Gowrie Lighting & Heating Company has been formed in this town and will apply for a franchise.

PELLA, IA.—A. J. McColl, of Des Moines, has purchased the plant at Pella, which furnishes electricity for light and power to the city, and it is reported intends improving the same.

FT. SCOTT, KAN.—Burns & McDonnell, Dwight Building, Kansas City, Mo., have been selected to prepare plans for water works improvements and municipal lighting plant at Ft. Scott.

CANEY, KAN.—John H. Heckman, of Coffeyville, will construct an electric light plant in this place at a cost of $10,000. Bids for construction will be received in about three weeks. P. G. Walker, of Coffeyville, is engineer.

HOLTON, KAN.—The plant of the Holton Electric Company was destroyed by fire on Oct. 2. The city, which recently voted to issue bonds for a combined water and light plant, offered the company $16,000 for the plant, which it refused.

CLAY CENTER, KAN.—We are informed with regard to the proposed electric light plant, bids for which were to have been opened on Aug. 15, that the matter has been indefinitely postponed, due to an injunction being served upon the city. It has not been settled when the letting will occur. The W. K. Palmer Company, 718 Dwight Building, Kansas City, Mo., are engineers.

LIBERAL, KAN.—At a recent meeting of the City Council a franchise was granted for an electric light plant. A company will be organized under the name of the Liberal Electric Light & Power Company, and will install a plant of about 100-kw capacity for commercial lighting The company will be in the market for equipment and machinery for the plant. T. J. McDermott is in charge of the work.

MOREHEAD, KY.—The electric light plant, which suspended operation several months ago, has been purchased by Hiram Bradley and James E. Braden, and was put into operation again Sept. 27. The franchise was first granted to J. E. Davidson, who was compelled through financial reverses to dispose of it.

WESTBROOK, ME.—Surveys are being made at Dundee Falls by the S. D. Warren Company for a large dam and power house, to furnish power for the increased size and capacity of the company's mill and as an auxiliary to the water company at that point.

HOULTON, ME.—Arthur Gould, of Presque Isle, president of the Maine & New Brunswick Electrical Power Company, states that the power house will be ready for the installation of machinery by Jan. 1, and expects to be able to supply electricity to Houlton by Feb. 1.

GREENFIELD, MASS.—At a special town meeting held Oct. 1, the sum of $1,200 was appropriated for street lighting.

LAWRENCE, MASS.—The Lawrence Gas Company has informed its patrons that motors now run by direct current must be replaced by motors taking alternating current. The change is made to improve the service.

SOUTH HADLEY FALLS, MASS.—The South Hadley Falls Electric Light Company is contemplating the installation of a 200-kw generator in its power station, which will more than double the present capacity of the plant.

MIDDLEBORO, MASS.—The new equipment for the municipal electric lighting plant has arrived. A 300-hp gas producer in two units, also a 125-hp Westinghouse gas engine and a 150-kw General Electric generator will be installed.

NEW MILFORD, MASS.—Through the breaking away of about 100 feet of the canal bank at Bull's Ridge, used to convey water to the plant of the New Milford Power Company, on Oct. 7, the power house was compelled to shut down, and will not probably resume operations for several days. The plant supplies New Britain, Southington, Cheshire, Naugatuck and Waterbury with electricity for light and power.

NEWTON, MASS.—The city of Newton has made a contract with the Newtown & Watertown Gas Light Company for lighting the streets of the city for a term of five years, to take effect Nov. 12. The company is to furnish arc lamps at $90 per lamp per year, and incandescent lamps at $14.50 each per year; gas lamps, $15 each. This is a reduction from the former rate of $10 a year on the arc lamps and $1 a year on incandescent and gas lamps. The new arrangement will save the city about $4,000 a year.

WOBURN, MASS.—The Board of Public Works has signed a contract with The Edison Electric Company, of Boston, for lighting the city for five years. The board also authorized Commissioner Kelly to instruct the Edison Company to install new lamps at once in the localities recommended by the board some weeks ago. The Mayor was also authorized to sign contracts for lighting the different municipal buildings. By the new contract there will be a saving of about $100 per month. The appropriation for lighting the city this year is $11,000.

BAY CITY, MICH.—A. Boston, deputy city recorder, writes that the question of consolidating the east and west sides municipal electric light plants is being considered.

GREENVILLE, MICH.—A special election was held Oct. 8 to vote on the proposition to issue bonds for $28,245 for the installation of municipal electric lighting plant.

BIG RAPIDS, MICH.—The Grand Rapids-Muskegon Water Power & Electric Company, of Grand Rapids, has secured the contract for lighting the streets of Big Rapids.

LANSING, MICH.—The Michigan United Railways Company, operating the Lansing Street Railway and the St. Johns line, has cancelled its contract with the Michigan Power Company, and is now receiving electricity to operate its lines from the Commonwealth Power Company, of Jackson.

LANSING, MICH.—The Michigan Power Company, which is developing power from the Grand River in this city and has water rights at Dimondale, Grand Ledge and other points on the river, is making extensive improvements to its plants. The company is also installing a large boiler to increase the capacity of its central heating plant. Thomas M. Keeley is superintendent.

DETROIT, MICH.—The Home Telephone Company has placed a contract with the Dean Electric Company, of Elyria, Ohio, for all switchboards and telephones for the new exchanges. The contract amounted to nearly $500,000. The Stromberg-Carlson Company, of Rochester, N. Y., and John A. Roebling Sons' Company, of St. Louis, Mo., have been awarded the contracts for cables amounting to over $500,000.

TRAVERSE CITY, MICH.—The Heald-Stevens Company, of Grand Rapids, has purchased the rights and holdings of the Boardman River Electric Light & Power Company and the Traverse City Gas Company. The transfer includes a contract for lighting the city, and all rights and equipment. The new company will immediately start work on a new dam which will develop 6,000 hp, and will rebuild the gas plant and increase it to four times its present capacity. The cost of the improvements to be made by the company will approximate $200,000. The new company will take charge Nov. 1.

DULUTH, MINN.—The Great Northern Power Company expects to be ready to furnish electricity in Duluth by the first of December. The power house on the St. Louis River and the substation in Duluth will be completed in a few weeks. Most of the towers carrying the transmission line from the power station to Duluth have been erected, and the stringing of the cables will be completed by the end of October. The company will have the first 10,000 hp ready for distribution by Dec. 1, and the additional installation of 20,000 hp is expected to be ready for operation by Feb. 1, 1907. H. P. Broughton is general manager.

McCOMB, MISS.—The plant of the McComb Electric Light & Power Company was badly damaged by a severe storm on Sept. 28, and will be out of commission for several days, while repairs are being made.

HATTIESBURG, MISS.—The Hattiesburg Traction Company will commence at once the construction of 7 miles of electric railway. The company will purchase line supplies, cars and equipment, including a 150-hp gas engine. Edward J. O'Beirne, Empire Building, Atlanta, Ga., is engineer and purchasing agent.

FULTON, MO.—At an election held recently the citizens voted to issue $20,000 in bonds to improve the municipal electric light and water works plant.

BEAVER CROSSING, NEB.—J. P. Martin is reported interested in the construction of an electric light plant.

CHARLESTON, N. H.—Surveys have been made and plans are now in progress by A. W. Dudley, of Manchester, for a municipal electric light plant. N. C. Dodge is chairman of committee.

DOVER, N. H.—The Twin State Gas & Electric Company has purchased the holdings of the Dover Gas Company. The former company is understood to be the principal owner of the Atlantic Shore line, which recently came into possession of the Dover, Portsmouth & York Beach Street Railway and all its branches. The Dover Gas Light Company controls electric lines in Dover, Somersworth, Rochester, Salmon Falls, N. H., and in Berwick, North Berwick and Lebanon, Me. Ivan L. Maloon succeeds T. Hawkins as general manager of the Dover company.

EAST ORANGE, N. J.—Edgar Williams, city clerk, writes that no action has yet been taken by City Council with regard to the construction of a municipal electric light plant. Awaiting report of engineer.

ORANGE, N. J.—Official press reports state that bids will be received until Oct. 29 by the committee on street lighting for three engines and electric generators, switchboard and 350 arc lamps, line equipment, consisting of poles and wire in place required in connection with the new municipal lighting plant for the city of Orange. Edward Cheetham is chairman.

JERSEY CITY, N. J.—The Hudson Companies, the company which purchased a controlling interest in the New York & Jersey Railroad Company and the Hudson & Manhattan Railroad Company, and is now constructing the twin electric railway tunnels connecting Jersey City with New York, has awarded the contract for the electrification of the tunnel lines, which will cost about $3,500,000, to the General Electric Company. Electricity to operate the system will be generated at a station to be built in this city on Washington Street, between Jersey City and Hoboken. The initial equipment will be capable of developing about 25,000 hp. The contract calls for two units of 6,000 kw capacity each and two of 3,000 kw each.

ESTANCIA, N. M.—The Estancia Rural Telephone Company, recently incorporated, is getting material for the construction of a telephone system. All towns in the county will be connected with the county seat.

CENTERPORT, L. I., N. Y.—The Centerport Improvement Society, it is stated, is contemplating the establishment of a municipal water works and electric light plant.

PHELPS, N. Y.—The village has granted a franchise to the Geneva, Phelps & Newark Electric Railroad Company, which proposes to build an electric railway from Geneva to Newark.

BROOKLYN, N. Y.—The Commercial Construction Company, of 1 Madison Avenue, New York, has been awarded the contract for installing the electric equipment in addition to and alterations in the teachers' training school, Borough of Brooklyn, for $21,685.

WARD'S ISLAND, N. Y.—Bids will be received until Oct. 24 by T. E. McGarr, secretary State Commission in Lunacy, Albany, for rewiring and fixtures for the east division of Manhattan State Hospital, Ward's Island. G. L. Heins, state architect.

NEW ROCHELLE, N. Y.—The Westchester Lighting Company is installing a complete forced draft arrangement for 3,800 hp of boilers. This apparatus, consisting of two special steel plate engine-driven fans is furnished by the B. F. Sturtevant Company, of Boston, Mass.

ONEIDA, N. Y.—The Madison County Light & Power Company, which is at present lighting the streets of the city, has sold out to the Hudson River Electric Power Company. The Empire State Company, a subsidiary company of the Hudson River Electric Power Company, recently obtained a five-year contract to light the streets of Oneida, beginning January next.

SYRACUSE, N. Y.—The Niagara, Lockport & Ontario Power Company, which furnishes electricity for operating the cars of the Syracuse Rapid Transit Company, has completed its duplicate transmission line nearly to Rochester, and will continue the work until it reaches the city line at Syracuse. This system, it is expected, will enable the company to deliver electricity without interruption into Syracuse, which it has not been able to do up to the present time.

NISKAYUNA, N. Y.—Work on the power house of the Hudson River Electric Power Company, which will be located on the Mohawk River in Niskayuna above Vischer's Ferry, will be started next spring. The power house will be built of brick and will be similar in size and capacity to the Mechanicsville plant. Seven General Electric turbo-generator sets having a capacity of 1,000 hp each will be installed. Bryce E. Morrow, of Glens Falls, is manager.

ELMIRA, N. Y.—The State Board of Railroad Commissioners has granted the application of the Elmira Water, Light & Railroad Company for approval of an increase of its capital stock from $1,000,000 to $2,000,000. The board has also granted the application of the company for consent to the issuance of a first consolidated mortgage for $5,000,000 on condition that but $3,605,000 in bonds under said first consolidation shall be issued, and on condition that the company shall secure the further consent of the board before issuing the remaining $1,395,000.

NEW YORK CITY.—The organizers of the Fort George Street Railway Company, organized several months ago, are now taking active steps toward carrying out their project, which will consist of building a trolley line from the Dyckman Street station of the Subway to the top of the Fort George hill. Owing to the abandonment of the plan for another deep Subway station with elevators at about 190th street, the Fort George section has been seriously handicapped. Its residents are still dependent upon the Amsterdam avenue trolley line, with a ten or fifteen minutes' walk to either the 181st street or Dyckman street subway station as alternative. The company proposes to give free transfers to the Subway at the Dyckman street station. Henry Morgenthau and his associates are prominently identified with the enterprise.

ASHTABULA, OHIO.—At a meeting of the City Council held Oct. 1 it was voted to sell the municipal lighting plant.

AKRON, OHIO.—George W. Carmichael & Company secured the contract for the power, heat and light plant for the court house and jail at $21,000.

SALEM, OHIO.—A company of business men in this place have purchased the plant of the Ford Lighting Company, of Elyria. The plant will be moved to this city at once and enlarged.

MT. VERNON, OHIO.—The Galion Southern Railway Company has been granted a 20-year franchise for an entrance into Mt. Vernon. Mayor Ball, of Fredericktown, Ohio, is chief promoter.

COVINGTON, OHIO.—At a meeting of the City Council held Oct 1 a resolution directing the city clerk to advertise for bids for proposals to superintend the construction of a municipal electric light plant was passed.

CHARDON, OHIO.—Improvements are being made which will about double the capacity of the Chardon municipal lighting plant. The building is being enlarged and a new engine and a generator are being installed.

LOWELLVILLE, OHIO.—Bids will be received until Oct. 15 by the board of trustees of the Lowellville electric light works, for furnishing materials and installing an electric light plant, comprising boiler, engine, dynamo and switchboard.

CLEVELAND, OHIO.—Secretary of State Laylin has rendered an opinion that the village of Lakewood cannot submit to a vote of the people the question of selling its lighting plant on the ground that such vote was not provided for by law.

LIMA, OHIO.—At a meeting of the stockholders of the Lima, Kenton & Marion Traction Company, held recently, the capital stock of the company was increased from $100,000 to $1,500,000. J. A. Vandergift was elected president and W. M. Embert, secretary.

OXFORD, OHIO.—The failure of the municipal plant at Oxford will oblige the State to install an independent lighting plant in the Miami University near that place. The State Emergency Board has made an appropriation covering the cost of such a plant.

SPRINGFIELD, OHIO.—Business men interested in the factories on Columbus Avenue have applied for a franchise for the Springfield Street Railway Company, to build a line on that street. The company has agreed to build a line if the property owners secure the franchise.

TOLEDO, OHIO.—The Central Union Telephone Company has placed a contract for the erection of a new exchange building to take care of the residence district in the western part of the city. The company is planning to divide the entire city into districts and erect other substations.

LORAIN, OHIO.—The city authorities of Lorain are considering the advisability of a municipal lighting plant. It is claimed that a plant to light the city can be built for $35,000. The city is now paying $14,000 a year for street lighting, and it is claimed that the facilities are not adequate.

TOLEDO, OHIO.—Riggs & Sherman Company has been engaged to make surveys and preliminary plans for a line from Toledo to Defiance by the way of Napoleon. The company has not yet been chartered, but is said to be independent of any of the numerous interests now operating in Ohio.

CINCINNATI, OHIO.—The directors of the Cincinnati & Suburban Bell Telephone Company have authorized the issue of $325,000 treasury stock, to be allotted at par to the present stockholders. The funds realized thereby will be used in the improvement of the company's plant and for the purchase of small exchanges in nearby towns.

GROVE CITY, OHIO.—Bids will be received until Oct. 22 by William C. Merritt, village clerk, for lighting the streets and alleys with 50 lamps of at least 80 cp each, to be generated by electricity, natural gas, gasoline, or by any other practical means; bids on lighting apparatus, fixtures, etc., and the operation of same to be stated separately.

COLUMBUS, OHIO.—Having failed to force the local lighting companies to make a five cent rate the City Council is now considering an ordinance establishing a seven cent rate. The Columbus Railway & Light Company will contest the ordinance. As a compromise ordinance the company proposes a rate of 10 cents with a ten per cent discount for cash.

ASHTABULA, OHIO.—The Ashtabula Rapid Transit Company is contemplating the extension of its line along the south and west sides of the city to connect with the lines of the Cleveland, Painesville & Ashtabula Railway and the Pennsylvania & Ohio Railway, forming a loop around the residence district of the town. E. R. McDowell is general superintendent.

CINCINNATI, OHIO.—Bids will be received until Nov. 2 by the board of trustees, commissioner water works, for furnishing, delivering and installing electric lighting, wiring, conduits and cables for the buildings and grounds at the eastern or river pumping station; also installing a telephone system for said buildings and grounds. Augustus H. Herrmann is president.

BELLEVUE, OHIO.—The Bellevue Home Telephone Company has appointed a committee to superintend the rebuilding of the exchange. The real construction will be changed to underground construction throughout the business district and important improvements in extensions will be made at the exchange. The company is stringing a number of country lines and installing cables.

MARIETTA, OHIO.—The Marietta, Belpre, Parkersburg, Pomeroy & Gallipolis Tramway Company has applied for a franchise from the County Commissioner for the proposed line from Belpre to Pomeroy. Franchises in other counties along the proposed route have been granted. The company is promoted by A. E. Boone, of Zanesville. It is stated that as soon as the franchises are secured the work will be started.

MANSFIELD, OHIO.—Two companies which have been working on a project for lines from Mansfield to Mt. Vernon have been consolidated. The companies include prospectors of the Mansfield & Southern Traction Company, which was headed by Thomas W. Latham and G. A. Bartholomew, of Cleveland, and a local company headed by S. N. Ford and Reid Carpenter, of Mansfield, and Rush Taggert, of New York, N. Y., who were formerly owners of the Mansfield city lines. One line will be built and it is stated this will be completed by next summer.

COLUMBUS, OHIO.—The Council on Oct. 1 passed on second reading the ordinance, to appropriate $140,000 for new equipment for the electric light plant. It is stated that the finance committee has decided to ask the Council to appropriate money for the employment of an electrical ex-

pert to report both on the condition of present equipment of the plant, etc., and on the prospects for commercial lighting by the city.

COLUMBUS, OHIO.—One of the large generators of the Municipal lighting plant at Columbus broke down last week and the Public Service Corporation is now supplying current for 1,500 lamps throughout the city.

EDMOND, OKLA.—Burns & McDonnell, Dwight Building, Kansas City, Mo., have been selected to prepare plans for water works and an electric light system for Edmond.

CHILOCCO, OKLA.—Bids will be received until Oct. 25 by S. M. McGowan, superintendent, Indian School, for furnishing and delivering as required during the fiscal year ending June 30, 1907, a 200-hp water-tube boiler, 120-hp engine, dynamo of 80-kw capacity, with switchboard, volt meters, circuit breakers, ammeters, rheostat, etc.

EUGENE, ORE.—W. S. and Leland Spencer, of Seattle, Wash., have filed notice of 50,000 miners' inches of water from Triangle Lake, in the Coast Range of mountains, 35 miles west of Eugene, for the purpose of developing electricity for lighting and power purposes.

READING, PA.—The plant of the Metropolitan Electric Light & Power Company was damaged by fire Sept. 28. One of the large generators was ruined, causing a loss of $2,000.

MT. GRETNA, PA.—At a recent meeting of the directors of the Mt. Gretna Light & Power Company, it was decided to rebuild the electric light plant on the camp-meeting grounds. A new engine will be installed and the rest of the equipment be put in first-class order.

CHESTER, PA.—The Beacon Light Company has been awarded a contract by the City Council to light the city for a term of five years. The company agrees to furnish 231 arc lamps of 1,200 cp each for $80 per lamp per year and 476 incandescent lamps, 16 cp each, at $10.50 each per year.

CATASAUQUA, PA.—The plant of the Lehigh-Northampton Gas & Electric Company of this place was sold at auction Sept. 28, to Thomas F. Diefenderfer, attorney for a majority of the bondholders, for $100,500, as the result of a suit in equity brought by the Peoples' Bank, of Wilkes Barre, trustees for the bondholders, who will reorganize the company.

PITTSBURG, PA.—The new East End plant of the Duquesne Light Company has been connected up with the Phipps power plant and will soon be ready to furnish electricity for lighting in that section of the city. The new plant in the East End occupies 56,000 square feet of space and represents an outlay of $500,000. The company will soon furnish electricity for lighting the Shadyside and East Liberty districts, and will shortly extend its lines to the Highland Park district.

NARRAGANSETT PIER, R. I.—Cazeau Pinard, owner of the Pinard cottages, contemplates the erection of an electric lighting plant and an ice plant to supply the wants of his cottage system.

CHARLESTON, S. C.—Bids will be received by Mordecai T. Endicott, chief bureau yards and docks, Navy Department, Washington, D. C., until Oct. 13, for boilers and accessories, coal-handling apparatus, electrical equipment, pumps and piping for the Navy Yard at Charleston, S. C.

YANKTON, S. D.—The Northwestern Telephone Exchange Company will make extensive improvements to the local exchange involving an expenditure of $40,000.

GLENWOOD, TEX.—The citizens are reported to be considering the construction of a joint electric light plant with Polytechnic Heights.

HILLSBORO, TEX.—The Commissioners of Hill County have granted the Union Central Light & Ice Company, of Hubbard, Tex., permission to extend its system to the towns of Mt. Calm, Dawson, Coolidge and Malone.

DALLAS, TEX.—The Southwestern Telegraph & Telephone Company is contemplating extensive improvements to its system in this city. Work will soon commence on the underground conduit system. The company will also build a new exchange building in South Dallas. J. E. Farnsworth is vice-president and general manager.

ESSEX JUNCTION, VT.—The Consolidated Electric Company, of which F. H. Parker, of Burlington, is superintendent, has purchased the extensive water power on the Winooski River at this place. The deal includes the Hunter, Shiland & Johnson dam, the water power owned by C. W. and S. A. Brownell, the grist mill and creamery owned by the W. B. Johnson & Company and the sawmill owned by S. A. Brownell. This water power will be developed at an estimated cost of $250,000.

MANCHESTER, VA.—The Electric Light Committee of Council is reported to be considering the feasibility of constructing an electric light plant.

FREDERICKSBURG, VA.—The Fredericksburg Water Power Company, owned by Joseph Swift, of Wilmington, Del., has been sold to a syndicate of Southern capitalists for $125,000. The purchase was made through William C. Whitner, of Rockhill, S. C. It is said the purchase was made for the Wabash Railroad, to be utilized in generating electricity for the much-talked-of electric line from Washington to Richmond.

ROSALIA, WASH.—A. D. Jones, of Spokane, has petitioned the Council for an electric light franchise.

TACOMA, WASH.—Plans have been submitted by the city electrician for a reinforced concrete sub-station building for the city light department, to cost from $15,000 to $20,000.

MORGANTOWN, W. VA.—The South Morgantown Traction Company has completed the grading of its proposed four-mile suburban line, and is now receiving bids for track laying, materials, etc. John Madigan, of Morgantown, is president.

MILWAUKEE, WIS.—R. G. Hunt & Company, of Chicago, Ill., have been enaged by the city of Milwaukee to prepare plans for and to superintend the construction of the municipal electric lighting plant.

MILWAUKEE, WIS.—At a meeting of Common Council Oct. 1, William Ross, president of the Milwaukee General Engineering Company, petitioned for a franchise to furnish 2,000-cp arc lamps to the city for ten years at 10 per cent above the cost.

MEETEETSE, WYO.—A company is being formed by capitalists of Meeteetse and Kirwin to erect a large power plant at Kirwin, to operate the mines at that place and an electric railway between the mining camp and Meeteetse.

WINDSOR, ONT.—The Windsor, Leamington & Chatham Railroad has decided to adopt electricity as its motive power. The company has placed a contract with the Westinghouse Company to install the single-phase system.

TORONTO, ONT.—The Toronto-Niagara Power Company has purchased the property between the Davenport Road and the Canadian Pacific Railroad tracks and extending westerly from Dufferin Street, and proposes to erect its shops and transformer station on this site.

WELLAND, ONT.—The Welland Electric Company has purchased the poles, lines, business and good will of the Welland Electric Light Company The latter retains its power house, water power and machinery. The purchasing company will obtain electricity from the Cataract Power Company to operate its system.

QUEBEC, QUE.—The construction of the Quebec & Saguenay Electric Railway, from St. Joachim to Malbaie, a distance of 58 miles, will commence soon.

MONTREAL, QUE.—The St. Francis Hydraulic Company has found the demand for power so great that it has been obliged to double its plant at D'Israeli, Que. The company has purchased from the Allis-Chalmers-Bullock, Ltd., of Montreal, a turbo-generator, a duplicate of the "Bullock" machine already installed, three new switchboards, transformers, etc.

Company Elections.

ROCKFORD, WASH.—At a meeting of the Spokane Electric Company, held recently, the following officers were elected: D. L. Huntington, of Spokane, president; H. L. Bleecker, of Spokane, vice-president; H. W. Collins, of Rockford, secretary, treasurer and general manager.

LOS ANGELES, CAL.—At the annual meeting of the stockholders of the Home Telephone Company, held recently, A. B. Cass was elected president to succeed Mr. Marble, resigned, and W. C. Patterson, vice-president. The company will spend $1,000,000 the coming year installing a complete system of automatic telephones in Los Angeles, and building two new stations. The company will also connect with United States Long Distance Company, of San Francisco and Oakland.

New Industrial Companies.

THE ELECTRIC TERMINAL ASSOCIATION, of Lyons, N. Y., has filed articles of incorporation, with a capital stock of $25,000, to construct street railroad terminals. The directors are C. A. Lux, H. C. Beatty, T. H. Mather, of Syracuse.

THE JACKSON CLOCK TELEPHONE COMPANY, of Portland, Me., has been incorporated with a capital stock of $1,000,000, to manufacture electrical appliances. Hayes Lougee, of Boston, Mass., is president, and J. G. Robinson, of Melrose, Mass., treasurer.

New Incorporations.

THOMASVILLE, ALA.—The Thomasville Manufacturing Electric Light & Power Company has been incorporated with a capital of $11,000 to construct an electric light plant here. The incorporators are: W. A. Scott, Jr., John S. Henson, W. D. Boyles and others.

FRESNO, CAL.—The Merchants' Independent Electric Company has been formed to furnish light and water. It is reported that the Hughes Hotel electric light plant has been leased for a term of 10 years and a large quantity of new machinery will be installed at once. Fred Dodd, proprietor of the Hughes Hotel in Fresno, and Arthur Gore, of Los Angeles, are among the stockholders.

NORWICH, CONN.—The Lebanon Street Railway Company has been organized and the following directors chosen: N. C. Barker, F. B. Fowler, L. E. Livermore, G. H. Hewitt, Isaac Gillette, S. W. Troop, J. Henry, John Clark and L. R. Smith. The directors have chosen the following officers: J. E. Livermore, of Lebanon, president; L. B. Smith, of Lebanon, secretary and treasurer; C. W. Comstock, of Norwich, attorney. The company voted to accept the charter which was granted by the last legislature.

WASHINGTON, D. C.—A certificate of incorporation has been filed with the recorder of deeds by the Waynesburg, Jefferson & Carmichael Telephone Company, the stated purpose of which is to construct and maintain telephone lines in all parts of the world. The incorporators are: Loranzo G. Warfield, J. B. Rohrer and F. L. Ward, of Washington, D. C., and T. B. Lee and W. H. Bailey, of Pittsburg, Pa.

HARMON, ILL.—The Green River Telephone Company has filed articles of incorporation, with a capital stock of $2,000. The incorporators are Elmer Cotton and others.

HAMMOND, ILL.—The Hammond Mutual Telephone Company has filed articles of incorporation with a capital stock of $5,000, to operate a telephone system. The incorporators are Frank P. Smith, S. W. Bandy and C. A. Hacker.

FORT WAYNE, IND.—Articles of incorporation have been filed with the Secretary of State for the Ft. Wayne & South Bend Railway Company, with a capital stock of $2,500,000. The purpose of the company is to construct and operate an electric railway connecting Ft. Wayne, South Bend and intervening towns and also to construct, acquire and operate street railway systems in towns and cities along the route, and to manufacture, sell and distribute electricity for light, heat and power for domestic and commercial purposes. The directors are John H. Grisamer, Gustav A. Wulkap, Charles A. Shorh, E. B. Swift, Perry A. Randall, W. F. Drimen, Charles M. Neizer, V. Brown and Fay P. Randall.

AUGUSTA, ME.—Articles of association have been filed with the State Board of Railroad Commissioners by the York & Oxford Railway Company. The company proposes to build a line from the terminus of the Atlantic Shore Line Railway in Springvale, through Sanford, Shapleigh, Acton, Newfield, Limerick, Parsonfield and Cornish, in York County; Porter and Hiram in Oxford County, and Baldwin to Bridgton Junction in Cumberland County. The line will be about forty miles long. The company has a capital stock of $160,000. The directors are Fred J. Allen and George W. Hanson, of Sanford; Ira H. Moore and A. P. Towle, of Newfield; Allen Gamer and O. L. Stanley, of Keezar Falls; J. Merrill Lord, of Parsonfield; Henry E. Eastman and Charles G. Moulton, of Limerick.

CORDER, MO.—Articles of incorporation have been filed for the Corder & Aullville Telephone Company, with a capital stock of $1,000. The incorporators are Nathan Corder, F. W. Brand, J. E. Blase and others

JEFFERSON, MO.—Articles of incorporation have been filed by the St. Louis & Montesano Railway Company, of St. Louis, for the purpose of building a railroad from St. Louis, beginning at the county line, to Flat River, in Francois County, a distance of 63 miles. The company has a capital stock of $4,000,000. The incorporators are Charles A. Gutke, A. Furer, L. A. Hall, Harry W. Gutke, B. Wasserman, all of St. Louis. The St. Louis, Kimmswick & Northern Railway Company, owned by the parties mentioned above, has secured a franchise for a road through St. Louis and Jefferson counties from the city limits.

NAPANOCH, N. Y.—The Honk Falls Electric Company, of Napanoch, has been incorporated with a capital of $15,000, to manufacture and use electricity for light, heat or power purposes and to light the streets and public and private places. The company proposes to operate in the towns of Warwarsing, Rochester, Marbletown, Hurley, Ulster, Rosendale, New Paltz, Gardiner and Shawangunk and the villages of Ellenville, Rosendale, and New Paltz, and the city of Kingston, Ulster County; the towns of Crawford, Montgomery, Newburgh, and Wallkill, and the villages of Montgomery, Walden, and the cities of Middletown and Newburgh, Orange County; the towns of Thompson, Liberty, Fallsburgh and Mamakating, and the villages of Monticello, Liberty and Wurtsboro, Sullivan County. Thomas Gray, of Ellenville, is one of the directors of the company.

COLUMBUS, OHIO.—Articles of incorporation have been filed for the Ohio & Southern Traction Company, with a capital stock of $75,000, by S. B. Hartman, F. W. Schumacher, James M. Butler, W. D. Baker and J. A. Hedges. The company proposes to build a line from the outskirts of Columbus to the Hartman farm, about 20 miles southwest of the city.

CLEVELAND, OHIO.—The Lake & River Transit Company, of Cincinnati, has been incorporated by representatives of Squire, Sanders & Dempsey, Cleveland attorneys, who formerly represented the old Miami & Erie Canal Transportation Company. The company is capitalized at $200,000, and proposes to operate boats on the Miami & Erie Canal from Cincinnati to Toledo with electricity from trolley wires or by traction from the canal bank.

COLUMBUS, OHIO.—The Marion & Western Railway, Light & Power Company has been incorporated with a capital stock of $200,000. The incorporators are John G. Webb, James A. Webb, George H. Holzbog, H. B. Harris and George Whysall. The Marion & Suburban Railway Company, of Columbus, has also been incorporated by the parties mentioned above, with a capital stock of $250,000. This company will operate street railways in Marion and lines extending from Marion to other towns in Marion County.

READING, PA.—The West Reading Power Company has been incorporated with a capital of $25,000, to supply electricity for light, heat and power to the citizens of Cumru Township and adjacent territory. Stockholders: Walter A. Rigg, J. Milton Miller and Harry H. Reigel, all of Reading.

HARRISBURG, PA.—A charter has been issued by the Secretary of State to the Midway & Burgeetstown Street Railway Company to build six miles of road in Washington County. The capital stock is $37,000. The directors are Charles W. Dollinger, of Pittsburg, president; John W. Thomas, V. A. Powell, J. B. Slack, L. W. Bircham.

MIFFLINBURG, PA.—A charter has been issued to the Lewisburg & Mifflinburg Electric Railroad Company by the Secretary of State. The capital stock is $60,000. The company will build a line from the center of Lewisburg to Mifflinburg, Pa. The officers and incorporators are: J. B. Nuss, of Bloomsburg, president; J. M. Nuss, of Nescopec, secretary, and O. B. Mellick, of Bloomsburg, treasurer.

VALLEY SPRINGS, S. D.—Articles of incorporation have been filed for the Beaver Bend Telephone Company, with a capital stock of $1,000, by J. M. Johnson and others.

MEXIA, TEX.—The Mexia Light & Power Company has filed articles of incorporation with a capital stock of $100,000, for the purpose of supplying water, light and power to the public. The incorporators are E. M. Turner, of Hillsboro, Joseph Nussbaum, and others.

TEXARKANA, TEX.—The Citizens' Light & Power Company has filed a charter for the purpose of installing a plant to furnish electricity for lighting and power in Texarkana. Capital, $50,000. E. E. Miller, Claud L. Shepherd and R. W. Rodgers are among the directors.

DALLAS, TEX.—The Texas Traction Company has been chartered with a capital stock of $3,000,000, to build an electric railway from Dallas to Sherman. Among the directors are Walter G. Clark, R. H. Baker, W. J. Neale, and Fred A. Jones. It is stated that the line has been financed and will be built at once.

ELGIN, UTAH.—The Light, Power & Water Company has been incorporated with a capital of $24,000, for the purpose of diverting the waters of Greene River for power and irrigation purposes. L. P. Hill is president and W. A. Morgan, secretary.

Legal.

LIABILITY OF A CITY.—The Indiana Supreme Court has rendered a decision holding that the operation of an electric light plant by a city to light its streets is not such a governmental capacity as to relieve the city from liability for injuries caused by its negligence in leaving a live wire where a person may come in contact with it, without his own fault.

LIGHTING IN MILWAUKEE.—The Milwaukee Electric Railway & Light Company has brought suit against the city of Milwaukee for approximately $140,000, alleged to be due for lights since its last contract with the city expired Dec. 15, 1905. Since the contract between the Milwaukee Electric Railway & Light Company and the city expired, President Beggs continued his service, setting a price to be effective until another contract had been concluded. The council kept putting this off from time to time, trying to get Mr. Beggs to lower the price he was charging for service. This he finally did, agreeing to make it $78 a year a lamp for a five-year contract. Several aldermen thought that a lower figure should be named and refused to sanction a contract at $78.

PAVING OF TROLLEY TRACKS.—The duty of repaving between street railway tracks has been decided to be obligatory upon traction companies in a case recently passed on by the Supreme Court of Pennsylvania. The city of Reading ordered asphalt pavement to be laid on a number of streets and notified the United Traction Company to lay similar pavements along its tracks. This was not done by the company, so the city executed the work and sued for its cost, securing a favorable verdict in the trial court and recently in the Supreme Court. The company's contention was that it was not required by its franchise to keep the street surface in repair and hence it could not be legally charged with the expense of the pavement. The Supreme Court's decision says: "When the State gives up a portion of one of its highways to a particular use, without providing that what has been the duty of the municipality as to it shall continue, such duty devolves upon the party acquiring the right to use it, and a street railway company, given the right to use such portion of a street as is needed for its tracks, in taking charge of it is charged with the duty of properly maintaining it. It is because the municipality, as the agent of the State, has charge of the streets, that it must maintain and keep them in proper repair, and when the State permits this charge, as to a portion of a street, to be committed to another, it must be understood as imposing upon such party the responsibility that formerly rested upon the municipality, unless in the grant, or the municipal consent thereto, of the right to use a portion of the street, such responsibility is expressly withheld and its imposition continued upon the municipality."

Obituary.

MR. H. ABBOTT.—A special dispatch from Wilmington, Del., of October 2, says: Howard Abbott, twenty-nine years old, an expert electrician and engineer, in the employ of the Wilmington City Electric Company, received 2,000 volts to-night and died instantly. Abbott was instructing a new employe at the switchboard, when he grasped an arc lamp circuit, the entire voltage being impressed upon his body.

Personal.

MR. C. W. McKILLIP, head of the complainant department of the Sacramento Electric, Gas & Railroad Company, has been appointed to the position of assistant general manager.

MR. J. ST. JOHN, general bookkeeper of the Milwaukee Gas Light Company, has accepted the position of secretary to the Muskegon Light & Traction Company, of Muskegon, Mich.

MR. J. W. KIRKLAND has been appointed vice-president and general manager of the McCall Ferry Power Company. He was for many years connected with the General Electric Company and for the last eight years, until his recent removal to New York, has been managing director of the South African General Electric Company, of Johannesburg, Transvaal.

MR. H. A. DUNCAN, electrical engineer in charge of the electric lighting department for the Interborough Rapid Transit Company, of New York, N. Y., has resigned to go with the Citizens' Railway & Light Company, of Ft. Worth, Tex. This company has recently been formed by the consolidation of several railway and lighting properties headed by Warren Bicknell, of Cleveland, Ohio.

MR. J. H. KINNEY, who recently retired as general manager of the Steubenville Traction & Light Company, Steubenville, O., was recently given a dinner at Stanton Park by his former associates, at which he was presented with a diamond pin as a token of esteem. Mr. Kinney goes to Salt Lake City to become superintendent of the Utah Gas, Light & Coke Company, under General Manager J. C. Ross, who was formerly general manager of the Steubenville company.

MR. JAMES J. SALLEY, of Orangeburg, S. C., has severed his connection with the electric light and water works system. Mr. Salley has been city electrician for several years, and as such has had charge of the plants under the Commissioner of Public Works. He will go to Bamberg to take charge of the city electric light plant there. Mr. F. L. Westerlund, of Chester, will succeed Mr. Salley.

MR. H. K. PAYNE, former manager of the Houston, Tex., Electric Company, and who for the past several months has been in charge of the purchasing department of the Stone-Webster syndicate, will now make Houston his permanent home and will be connected with Mr. Fred A. Jones, consulting engineer, and who has a number of extensive engineering enterprises on foot. Mr. Payne will have charge of the affairs of the Houston office.

MR. C. W. RICKER, formerly engineer of power houses, sub-stations and electrical distribution for the Interborough Rapid Transit Company, of New York, N. Y., has become associated with the Cleveland Construction Company, of Cleveland, Ohio, as electrical engineer in charge of the electrical end of the work on several lines which this company is now building in the Central West. Mr. Ricker will have his headquarters in the Schofield Building, Cleveland, Ohio.

MR. C. F. BAKER has been engaged by Mr. L. B. Stillwell as superintendent of power and construction in connection with the engineering and operating contract which Mr. Stillwell has recently executed with the United Railways & Electric Company of Baltimore. Mr. Baker has filled the office of President of the American Railway, Mechanical & Electrical Association, and has also taken a prominent part in the New England Railroad Club and of the New England Street Railway Club. For many years Mr. Baker was with the West End Street Railway Company of Boston, and the Boston Elevated Railway Company in charge of the construction and operation of their power plants and rolling stock.

MR. W. H. HURLBURT.—Mr. W. H. Hurlburt, general manager of the Oregon Water Power & Railway Company's lines, will retire from the service Oct. 1. He says he does not expect to return to railroading, as he thinks that after 36 years spent in the service, he is entitled to a rest. Mr. Hurlburt was president of the O. W. P. prior to its consolidation with the other electrical interests into the Portland Railway, Light & Power Company. He has been with the O. W. P. since the company was formed a number of years ago. The management of the O. W. P. lines will continue to be under the direction of F. I. Fuller, manager of the traction department of the electrical merger.

Trade Publications.

TRAINING SCHOOL FOR PRINTERS.—The Jenny Electric Mfg. Company, of Indianapolis, has issued a very neat colored leaflet as to this school, part of the Winona Technical Institute, which has a Jenney motor drive for each machine and press, designed and built specially for the service required. The plant is therefore a model and example.

TROLLEY HARPS AND RETRIEVERS.—"Some New Electric Railway Specialties" is the title of Bulletin 126, just issued by the Central Laboratory Supply Company, of La Fayette, Indiana. This publication describes in detail this company's new trolley harp and improved trolley retriever. The company will be glad to send the bulletin on request, and other data and information as to these devices.

HUBBELL SPECIALTIES.—Harvey Hubbell, Inc., of Bridgeport, Conn., have issued a very complete new catalogue, No. 9, of numerous electrical specialties, with prices. It is a small, thick oblong of 125 pages, all the appliances being shown, accompanied by brief data, code words, etc. Current taps, attachment plugs, full sockets, lamp guards, shades and all the other well-known Hubbell devices are included.

PROFIT BRINGING LIGHT.—An admirable pamphlet with this title is being distributed by I. P. Frink, 551 Pearl Street, New York, dealing with the proper employment and utilization of light in stores and windows. The brochure illustrates the application of a number of the Frink specialties, such as window reflectors, mirror shades for windows, reflectors for lighting counter cases, store clusters, wall and detached cases, illuminated signs, art gallery lighting, special appliances, such as portable reflectors, etc. Mr. G. Frink Spencer has recently executed some notable orders, and this pamphlet gives an excellent idea of the nature and quality of his work.

WAGNER ELECTRIC MFG. COMPANY.—The Wagner Company, of St. Louis, has just issued a neat illustrated pamphlet, ordinary envelope size, which covers its whole line of apparatus, including power and lighting transformers, single-phase motors, elevator motors, vertical motors, etc., giving sizes and types of the various lines, accompanied by references to the bulletins that describe each line in more detail. This pamphlet is of interest to central stations and others operating with alternating current.

HOLTZER-CABOT LITERATURE.—The Holtzer-Cabot Electric Company, of Brookline, Mass., has recently prepared some excellent trade literature devoted to recent productions. These comprise the following: Circular entitled, "Twelve Timely Telephone Topics," which it is mailing to the various telephone exchanges throughout the county; booklet "148-AA," covering intercommunicating telephones used in connection with telephone exchanges; bulletin "151-A" covering its various lines of electric bells, particularly the water-tight and high-voltage bells which are offered as something new; this also illustrates the new "return call" bell and button; bulletin "154," covering its line of automatic gas lighting apparatus; bulletin "203," describing transmitters, transmitter arms and induction coils; bulletins "301-A and 305-A," covering its type "E" enclosed and semi-enclosed motors and its small direct current motors and dynamos respectively.

News of the Trade.

THE LORD ELECTRIC COMPANY, Boston, will distribute at the Electric Railway Convention, Columbus, a neat little paper cutter and request all those wishing to possess one to make their wants known.

I. P. FRINK, 551 Pearl Street, New York City, has installed his reflector system of lighting in the big new Altman store on Fifth Avenue, and the effect is admirable, especially in the dome. This is one more of the numerous department stores that owe their effective illumination to the Frink apparatus and methods.

THE BRYANT ELECTRIC COMPANY, of Bridgeport, Conn., manufacturers of electric specialties, has awarded the general contract for the erection of an addition to its plant. The structure will be of brick, one story high, and its dimensions will be 41x153 feet. The building will be used for a plating and buffing room.

THE F. BISSELL COMPANY, of Toledo, O., is pushing its new "H. & M." safety switch, which is intended to protect lines from any sneak or foreign current, and which is claimed to be instantaneous and better than fuses; and worth putting on the circuit not only because it avoids the damage, but costs nothing whatever for electricity. It was illustrated recently in these pages. A circular on the subject will be sent to anyone interested.

HIGH TENSION INSULATORS.—The Electrose Manufacturing Company, of 127-137 North Tenth Street, Brooklyn, N. Y., has a remarkably fine insulating material in its Electrose, which is specially adapted for insulators and insulating parts for high tension currents, on power transmission circuits and electric railways. It is being employed exclusively on the new transmission line now in course of construction by the Canadian Niagara Power Company, from Canada to Buffalo. Mr. Louis Steinberger, the president, has designed such insulators for 80,000 and 100,000 volts, commercial service, and is quite ready for 150,000.

W. N. MATTHEWS & BRO., of 227 North Second Street, St. Louis, have taken a space 20 x 20 feet in Section B, Spaces 18 and 19, Building 6, at the Street and Interurban Railway Convention to be held at Columbus, Ohio, October 15th to 19th, and are going to exhibit four corner poles which will show the Kearney cable clamp and the Stombaugh guy anchor under actual conditions. One of the four poles is made up in the old manner to more clearly show the advantages and the saving to be gained by the use of the Kearney cable clamp. Each pole is anchored by a six-inch Stombaugh guy anchor. In addition to the K. C. C. and S. G. A. Matthews & Bro. will have a working exhibit of their new money-saving specialty, the Lima jack box. They will have one installed on each pole, and it will be possible to talk by means of a portable 'phone from one pole to another. This scheme will show the advantages of the Lima jack box in a splendid manner. The "Hold Fast" lamp guard will also be exhibited, and delegates will be invited to try to break a lamp in them. The firm will be represented by Mr. Claude L. Matthews and James R. Kearney. The latter is the inventor of the Kearney cable clamp and a construction man of wide experience, as noted in a recent biographical sketch in these columns.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCT. 2, 1906.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N. Y.]

832,072. REGULATOR FOR PRIME MOVERS; Lamar Lyndon, East Orange, N. J. App. filed June 26, 1905. Details of a mechanism for opening and closing the throttle of a steam engine by variations in the load of a dynamo. Magnetic devices are effective to throw clutches into action to open or close the throttle.

832,116. THERMOSTAT; Frank E. Austin, Westbrook, Me. App. filed Dec. 26, 1905. A spring impelled plunger is normally held against movement by a lever arm which is jointed in the middle by a solder connection. In case the solder melts the plunger is impelled to close an alarm circuit.

832,121. TELEPHONE SYSTEM; William W. Dean, Chicago, Ill. App. filed Dec. 23, 1902. In a telephone system, the combination with a telephone-line, of an electromagnetic line signaling device having

differentially-disposed windings and of different magnetic effects when calling-current from the substation flows through said windings, and means for equalizing the magnetic effects of said windings when a connection is established with the line to render the same inoperative.

832,135. COMBINED TELEPHONE-RECEIVER AND MICROPHONE; Carl E. Ljungman, Robert O. P. Berglund and Walter A. W. E. Hjorth, Stockholm, Sweden. App. filed Feb. 14, 1906. In a telephone apparatus with receiver and microphone within the same casing, a curved screen or disk arranged between the diaphragms of the microphone and of the receiver.

832,137. RAILWAY SWITCHING AND SIGNALING APPARATUS; William Macomber, Buffalo, N. Y. App. filed Feb. 20, 1905. This patent and the following series to the same inventor, relate to improvements in a block signal system designed to present signals when switches along the track are operated. The present patent pertains particularly to preventing short circuit between the connections having any effect on the signals.

832,138. RAILWAY SWITCHING APPARATUS; William Macomber, Buffalo, N. Y. App. filed Feb. 20, 1905. Relates to modifications of the above.

832,139. RAILWAY SWITCHING APPARATUS; William Macomber, Buffalo, N. Y. App. filed Feb. 20, 1905. Provides means whereby the rail switch may be returned to its initial position at any time after a movement has been begun and before the switch has gone to full reverse and been locked.

832,140. RAILWAY SWITCHING APPARATUS; William Macomber, Buffalo, N. Y. App. filed Feb. 20, 1905. Provides for moving and locking the rail switch, and mechanism for making and breaking the electric circuits with which it is used. Has an improvement in a mechanical clutch mechanism for operating the switch.

832,147. REAR LIGHT INDICATOR FOR AUTOMOBILES; Leo F. Murphy, Detroit, Mich. App. filed Sept. 5, 1905. A bar of expansible material is held above the flame of a lamp and closes an alarm circuit whenever the lamp is extinguished.

832,153. ELECTRIC SIGNALING APPARATUS; Charles J. O'Neill, Washington, D. C. App. filed Feb. 4, 1905. A metallic strip with curved ends is spring pressed into engagement with the track rails so as to be displaced by the locomotive flanges in passing. A mechanical connection is made to a switch blade through a mechanism which throws the blade oppositely at successive actuations.

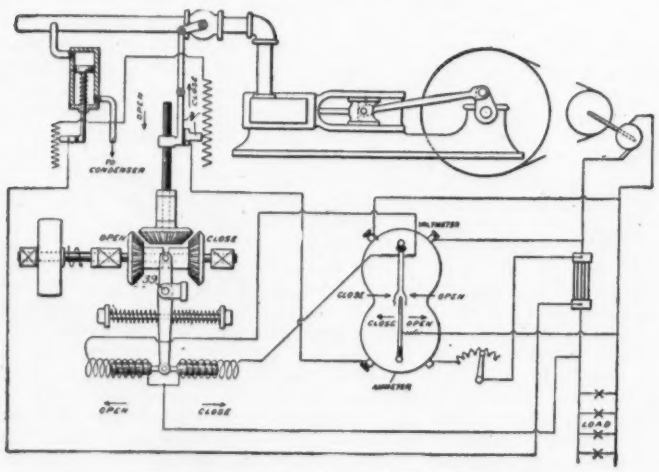
832,165. RAILWAY SWITCH OPERATING AND CONTROLLING APPARATUS; Wilmer W. Salmon, Buffalo, N. Y. App. filed July 15, 1901. This patent and the series following relate to the same general signal installation as covered by patent 832,137 (above referred to) and the ones following. This patent covers means whereby the movement of the switch rail may be reversed at any point of movement and restored to its initial position. And also by which the actuating current is automatically cut off from the motor when a complete movement has taken place.

832,166. RAILWAY SWITCHING AND SIGNALING APPARATUS; Wilmer W. Salmon and Frank L. Dodgson, Buffalo, N. Y. App. filed Jan. 6, 1906. Provides for the control of an outlying switch and signal by the employment of a single circuit which accomplishes various functions.

832,174. RAILWAY SIGNALING APPARATUS; John D. Taylor, Buffalo, N. Y. App. filed Jan. 22, 1904. Mechanism and arrangement of circuits for returning the signal to normal position before the controller is put at indication. Also secures dynamic indication when the controller is put at indication.

832,175. RAILWAY SWITCHING APPARATUS; John D. Taylor, Buffalo, N. Y. App. filed Jan. 22, 1904. Relates to modifications of the above.

832,181. ELECTROMAGNETIC DEVICE; William W. Dean, Chicago, Ill. App. filed June 19, 1903. An arrangement for supporting impedence coils of telephone switchboards in a single shell or casing for a plurality of coils rather than separate casings for each coil.



832,072.—Regulator for Prime Movers.

832,185. RIGHT ANGLE ADJUSTABLE CROSSING FOR ELECTRIC RAILWAYS; Edward E. Gilmore, Philadelphia, Pa. App. filed Sept. 27, 1905. The crossing has arms with a swivel plate connection at their center whereby the arms may be arranged at different angles to suit any desired crossing.

832,192. RAILWAY SWITCHING AND SIGNALING APPARATUS; Winthrop K. Howe, Buffalo, N. Y. App. filed Aug. 29, 1905. Provides means whereby the signal circuit is not completed until after the switch points are moved to their proper position and locked, and has means for breaking the signal circuits when the switch points are displaced or unlocked.

832,193. RAILWAY SIGNALING APPARATUS; Winthrop K. Howe, Buffalo, N. Y. App. filed Nov. 27. 1905. Provides means for controlling the switching movement, or unlocking in manual control block signal systems.

832,202. SAFETY DEVICE FOR RAILROADS; Constantin Klinik, Tarnowitz, Germany. App. filed Feb. 6, 1906. Each train has a flexible connection about 600 yards long trailing therefrom in a conduit between the track rails so that a following train will be automatically stopped when it arrives in the danger zone determined by such flexible connection.

832,297. SAFETY DEVICE FOR ELECTRIC SIGNALS; Fred H. Corey, Schenectady, N. Y. App. filed June 16, 1904. In order to prevent accident from failure of electric lights in signal apparatus, the patentee has a relay which sets a train stop in case of interruption of the lighting current.

832,302. METHOD OF SEALING METAL INTO GLASS OR OTHER VITREOUS MATERIAL; Carl E. Ernst, Schenectady, N. Y. App. filed June 12, 1903. A plan for fusing nickel steel into glass so perfectly that it can be used in place of the platinum leads now employed. Patentee stretches the wire in a long tube and exhausts the air and finally heats the tube so as to contract it on the wire at intervals.

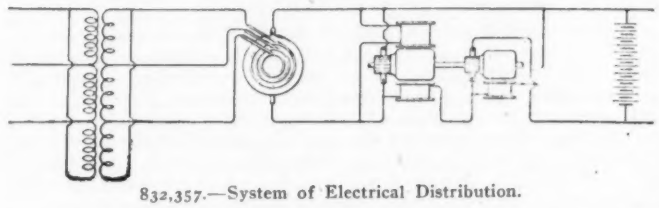
832,312. SECTION INSULATOR FOR ELECTRIC RAILWAYS; Edward E. Gilmore, Philadelphia, Pa. App. filed Sept. 27, 1905. The hanger is made with recesses to receive the wire at each end and pivoted shoes in such recesses are effective to clamp the wire firmly in place.

832,353. COMMUTATOR; Roger S. White, Philadelphia, Pa. App. filed Oct. 14, 1902. In watt-hour meters where the commutators are made use of as a roller bearing, the segments are dovetailed into one another so that the roller bearing action will be more perfect.

832,354. MAGNETO ELECTRIC GENERATOR; Joseph A. Williams, Cleveland, O. App. filed May 14, 1906. The field magnets of the generator are mounted on the base so as to be angularly adjustable into any desired angular position.

832,357. SYSTEM OF ELECTRICAL DISTRIBUTION; Ernst J. Berg, Schenectady, N. Y. App. filed Apr. 25, 1900. The combination of mains, a source of current supply therefor, a generator with its armature in series with one of said mains, a motor mechanically connected to said generator, and means for automatically varying the speed of said motor in response to variations of load on said mains.

832,363. VAPOR TUBE STARTING DEVICE; Theodore Bodde, New York, N. Y. App. filed Mar. 16, 1904. A supplemental chamber is formed in a mercury vapor bulb through which the current initially passes to vaporize a small quantity of mercury and establish an atmosphere through which the current can pass between the main electrodes.



832,357.—System of Electrical Distribution.

832,401. CABLE GRIP; Philip J. Martin, Syracuse, N. Y. App. filed Sept. 2, 1905. A tubular basket is arranged to be loose around the lead sheathing of a cable and connections are established so as to tighten the basket on the cable to grip the same when tension is applied.

832,416. ELECTRIC RAILWAY; Leon W. Pullen. Camden, N. J. App. filed May 18, 1905. Relates to railways of the type having spaced contact plates inset in the roadbed. These are automatically energized by magnets on the car during its passage.

832,425. INTERCOMMUNICATING TELEPHONE; Lambert Schmidt, Weehawken, N. J. App. filed Sept. 16, 1905. In an intercommunicating telephone, a station-indicator comprising a name plate or dial displaying openly the various stations, a pointer above said dial for selecting the stations, one push-button for all the stations passing through said dial and through said pointer, said pointer being so arranged as to be laterally actuated when the push-button is turned and remaining stationary when the push-button is depressed.

832,443. TELEPHONE SYSTEM; Parl Arnheim. Hamburg, Germany. App. filed June 25, 1902. The combination with a line and subscribers' stations, of a grounded magnet and its armature, a magnetically-operated switch to connect a station to line and included in a local circuit closed by said armature and clock-operated mechanism released by said switch to close a local circuit through the switch and signal at the station, substantially as described.

832,462. AUTOMATIC ELECTRIC BRAKE; Augustus L. Duwelius, Cincinnati, O. App. filed May 7, 1904. The usual hand brake is employed and additional means are arranged to apply electric power when the brake is actuated.

832,508. COMBINED BOX FOR MOLDING AND IRON ARMORED CONDUIT; Silas D. Slocum, Alexandria, Va. App. filed Sept. 18, 1905. A form of outlet box having a sliding plate which is adjustable so as to closely receive the cables of various sizes issuing from the box.

832,509. OUTLET BOX; Silas D. Slocum, Alexandria, Va. App. filed Sept. 18, 1905. Improvements in the knock-out areas of an outlet box. The thickness of the metal is gradually reduced in successive parallel lines across the circular area so that a bolt at one point only of the area will be effective.

832,511. ELECTRIC FURNACE; Edwin A. Storey, Newark, N. J. App. filed Sept. 13, 1905. A di-electric furnace having tubular conductors extending through the walls of the furnace and a resistor supported by said conductors and an additional conductor adapted to contact with said resistor.

832,544. AUTOMATIC TROLLEY GUARD; John R. French, Los Angeles, Cal. App. filed Nov. 15, 1905. The trolley pole has a supplemental hinged section at its upper end which moves relatively to the pole when the latter leaves the wire and moves a slide valve to admit air to a retrieving cylinder.

832,548. SYSTEM OF RAILWAY SIGNALING; Harry L. Johnson, Topeka, Kan. App. filed Apr. 29, 1905. A spring blade is held adjacent to the track rail and in the path of the wheel flange so as to have contact established therewith by the passage of a train.

832,562. TELEPHONE CALL-BOX; Anthony Van Wagenen, Sioux City, Ia. App. filed July 30, 1903. In a telephone call-box, the combination with contact mechanism comprising a toothed member, a receiver-hook provided with means tending to raise it, and means operated by said hook for holding said toothed member in different positions, of means for preventing engagement of said holding means with said toothed member during motion of the latter.

832,577. TIME LIMIT CIRCUIT BREAKER; Edward M. Hewlett, Schenectady, N. Y. App. filed Feb. 11, 1899. A clock-driven cylinder is tripped into action by an overload, but is not effective to open the circuit until a predetermined time has elapsed.